

## Order CHARADRIIFORMES

A large, diverse assemblage of small to medium-large (12–75 cm long) limicoline, pratincoline, aquatic or terrestrial birds. Cosmopolitan from Arctic to Antarctic regions; in all sorts of maritime, freshwater and open terrestrial habitats (including deserts) with a few (woodcocks and snipes) even using dense forests. Once known as Limicolae or Laro-limicolae (e.g. Mayr & Amadon 1951); colloquially, the assemblage (excluding alcids, skuas, gulls, terns and skimmers) is often referred to as waders (especially in Britain) or shorebirds (especially in North America).

About 350 species in 19 families, though taxonomic treatments vary. Following families recognized (mostly based on recent reviews of Order [Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990]):

Thinororidae	seed-snipes; four species, S. America.
Pedionomidae	Plains-wanderer; monotypic, Aust.
Scolopacidae	sandpipers, snipes and allies; c. 85 species, cosmopolitan.
Rostratulidae	painted snipes; two species, s. America and Old World.
Jacaniidae	jacanas; seven species, pantropical.
Chionididae	sheathbills; two species, Antarctica and subantarctic islands.
Burhinidae	thick-knees, stone-curlews; nine species, widespread in Old World and two in Neotropics.
Haematopodidae	oystercatchers; c. 11 species, worldwide in tropics and temperate regions.
Recurvirostridae	avocets and stilts; about seven species, worldwide in tropical and temperate regions.
Ibidiorhynchidae	Ibisbill; monotypic, central Asia.
Charadriidae	plovers and lapwings; c. 60 species, cosmopolitan.
Pluvianellidae	Magellanic Plover; monotypic, S. America.
Dromadidae	Crab Plover; monotypic, Arabian region.
Glareolidae	pratinoles, coursers, and Egyptian Plover; c. 15 species, widespread in Old World.
Stercorariidae	skuas and jaegers; about seven species, mostly in Arctic and Antarctic regions.
Rhynchopidae	skimmers; three species, pantropical.
Laridae	gulls; c. 47 species, cosmopolitan.
Sternidae	terns; c. 42 species, cosmopolitan.
Alcidae	auks; c. 20 species, Arctic and temperate regions of n. hemisphere.

Apparently monophyletic. Pteroclididae (sandgrouse) probably sister-group of Charadriiformes (e.g. Fjeldså 1976, 1977; Sibley & Ahlquist 1990; BWP), though whether best placed within Charadriiformes or in separate order is debated. Flamingoes (Phoenicopteridae) and divers (Gaviidae) have also been treated as Charadriiformes (Olson & Feduccia 1981; Fjeldså 1976, 1977) but DNA–DNA hybridization studies (Sibley & Ahlquist 1990) inconsistent with these theories. Affinities to other orders still controversial; DNA–DNA hybridization has suggested closest links are to large waterbirds, such as storks, herons and allies, Pelicaniformes, Procellariiformes, penguins, grebes, divers (Gaviidae) and also Falconiformes. All these were combined in huge order Ciconiiformes by Sibley & Ahlquist (1990).

Taxonomy and relationships reviewed in Sibley & Ahlquist (1990), Christian *et al.* (1992) and BWP (and references therein). Recent reviews have included: patterning of downy young (Jehl 1968; Fjeldså 1976, 1977), osteology (Strauch 1978; Mickevitch & Parenti 1980; Olson & Steadman 1981), DNA–DNA hybridization (Sibley *et al.* 1988, Sibley & Ahlquist 1990) and electrophoresis of tissue proteins (Christian *et al.* 1992). The studies of allozymes, DNA–DNA hybridization and the most recent osteological study of the entire order (Strauch 1978) have agreed in finding two or three well-knit, monophyletic assemblages within the Charadriiformes: scolopacids and allies (Thinororidae, Pedionomidae, Scolopacidae, Rostratulidae, Jacaniidae) and charadriids and allies (Chionididae, Burhinidae, Haematopodidae, Recurvirostridae, Ibidiorhynchidae, Charadriidae, Pluvianellidae, Dromadidae, Glareolidae, Stercorariidae, Rhynchopidae, Laridae, Sternidae, Alcidae); Strauch (1978) treated Alcidae as separate lineage, but skeletons may be so highly modified for foot-propelled diving that they do not reflect relations well (Sibley & Ahlquist 1990); gulls and allies have also been regarded as a separate lineage (Christian *et al.* 1992) or as allied to charadriids (e.g. Sibley & Ahlquist 1990). Further relationships within the Order discussed in introductions to families.

Because the Order comprises so many species and adaptations are so diverse, few characters shared by all species; those that are shared are mostly anatomical features of the skull, e.g. most or all have schizorhinal nostrils, schizognathous palates, well-developed vomer, lachrymals fused with ectethemoid and pre-frontal bones, well-developed supra-orbital grooves; see Olson & Steadman (1981) for more information on osteological characters. Wings usually have 11 primaries, with p10 longest and p11 minute; 15–24 secondaries; diastataxic except in *Scolopax minor*, as far as is known. Usually 12 tail-feathers. Necks usually rather long with 15–16 cervical vertebrae. Oil-gland bilobed and tufted. Syrinx, tracheo-bronchial; two carotids (type A-1 of Glenny 1955); caeca present. Legs usually rather long; hind toe small or lacking in most but all toes greatly elongated in Jacaniidae. Feathers with small thin afterfeathers. Normally two moults annually: complete post-

breeding and partial pre-breeding; some jacanas and alcids have flightless periods when moulting remiges. Young, downy, usually with intricate cryptic patterns on upperparts of three chief types: pebbly, spotted and striped, matching characters of habitat (Fjeldså 1976, 1977): precocial, nidifugous usually, self-feeding or not depending greatly on parents.

Thirteen families recorded in HANZAB region, with 54 species breeding, 41 occurring as regular non-breeding migrants and c. 38 as accidentals or probable accidentals. Scolopacidae, Stercorariidae, Laridae and Sternidae will be dealt with in Volume 3 of HANZAB.

#### REFERENCES

- Christian, P.D., et al. 1992. *Aust. J. Zool.* 40: 291–302.
- Fjeldså, J. 1976. *Vidensk. Medd. dansk. Natur. Foren.* 139: 179–243.
- 1977. *Guide to the Young of European Precocial Birds*. Scarv Nature Productions, Tisvildeleje.
- Glenny, F.H. 1955. *Proc. US natn. Mus.* 103 (3346): 525–621.
- Jehl, J.L., Jr. 1968. *Mem. San Diego Soc. nat. Hist.* 3.
- Mayr, E., & D. Amadon. 1951. *Am. Mus. Novit.* 1496.
- Mickevich, M.F., & L.R. Parenti. 1980. *Syst. Zool.* 29: 108–113.
- Olson, S.L., & A. Feduccia. 1981. *Smithson. Contrib. Zool.* 323: 1–24.
- , & D.W. Steadman. 1981. *Smithson. Contrib. Zool.* 337: 1–25.
- Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds of the World*. Yale Univ. Press, New Haven.
- , & B.L. Monroe. 1990. *Distribution and Taxonomy of the Birds of the World*. Yale Univ. Press; New Haven.
- , et al. 1988. *Auk* 105: 409–423.
- Strauch, J.G., Jr. 1978. *Trans. zool. Soc. Lond.* 34: 263–345.

## Family LARIDAE skuas, jaegers, gulls and terns

A large assemblage of small to very large charadriiform seabirds. We recognize four subfamilies within the Laridae following Mayr & Amadon (1951), AOU (1983).<sup>1</sup>

**Stercorariinae** Skuas and jaegers; about six species; cosmopolitan.

**Larinae** Gulls; c. 47 species; cosmopolitan.

**Sterninae** Terns; c. 42 species; cosmopolitan.

**Rynchopinae** Skimmers; three extralimital species, pan-tropical.

Taxonomic rank given to above groups varies greatly. Considered four families within suborder Lari (e.g. Campbell & Lack 1985; BWP), or four tribes within subfamily Larinae (e.g. Sibley *et al.* 1988; Sibley & Ahlquist 1990; Sibley & Monroe 1990). Others have divided Lari into three families (Stercorariidae, Laridae and Rynchopidae) with gulls and terns usually considered subfamilies within Laridae (e.g. Wetmore 1960; Judin 1965; Hackett 1989; Peters). Moynihan (1959) divided the group into two subfamilies, Stercorariinae, containing the skuas, and Larinae, containing gulls, terns and skimmers in three tribes. Study of skeletal and external morphology of suborder 'Lari' (our Laridae) was mostly unable to cluster gulls and terns satisfactorily and found group surprisingly uniform (Schnell 1970a,b). Despite lack of agreement on taxonomic ranking of above groups, monophyly of Laridae is not in doubt. Studies of biochemistry (Christian *et al.* 1992), DNA–DNA hybridization (Sibley & Ahlquist 1990), downy young (Fjeldså 1977) and skeletal morphology (Strauch 1978; Mickevich & Parenti 1980; Chu 1995) generally agree in finding close relation with Glareolidae (pratincoles) and Dromadidae (Crab Plover *Dromas ardeola*). DNA–DNA hybridization suggests Alcidae (auks) also closely related (Sibley & Ahlquist 1990), though this contradicted by studies of skeletal morphology (e.g. Strauch 1978; Chu 1995).

Body-form varies greatly, from small and slender in some gulls and terns, to robust and thickset in skuas, jaegers, some gulls and a few terns. Differences in size between sexes slight; males usually larger but females larger than males in Stercorariinae. Wings usually long, narrow and pointed, but broader and more rounded in some; 11 primaries; p10 longest, p11 minute; 17–24 secondaries. Tail has 12 rectrices; shape varies: in Stercorariinae, central rectrices project beyond rest of tail and greatly elongated in adult breeding plumages of *Stercorarius*; in most Sterninae and Rynchopinae, outer rectrices elongated and tail forked; in Larinae, usually square. Bill, varies, though usually rather short and stout, with prominent gonydeal angle; rather fine in some Larinae and Sterninae; tip pointed in Sterninae, decurved in strong hook in Stercorariinae. Bill highly modified for unique foraging methods in Rynchopinae (Zusi 1962). Lack cere, except in Stercorariinae. Nostrils schizorhinal and perforate, with no median septum. Legs, short and stout; attached near centre of body; tibiae partly bare; tarsi, short and typically scutellate in front. Four toes; hindtoe, short, raised, sometimes rudimentary or absent; front toes, fully webbed (webs somewhat incised in some). Claws, moderately long, strong, laterally compressed. Caeca ranges from large (Stercorariinae) to poorly developed (Rynchopinae, Sterninae). Supra-orbital salt-glands well developed.

Plumages mainly browns, black, white and greys. Colours of bare parts often striking and often showing marked variation with both season and age. Adults moult twice annually: (1) a post-breeding (pre-basic) moult to non-breeding plumage, which is complete (with apparent exception of *Larus sabini*); and (2) a pre-breeding (pre-alternate) moult to breeding plumage, which is almost always partial (but see *Larus pipixcan* and *L. sabini*); some terns also undergo one or two pre-supplemental moults of inner primaries. Primaries moult outwards.

Hatch in natal down, which is replaced by juvenile plumage; downy young precocial but more dependent on

<sup>1</sup> This treatment differs from the arrangement presented in the introduction to the Charadriiformes in Volume 2 of HANZAB (p. 648), where these four subfamilies were listed as families. Recent major studies in avian classification (particularly by Sibley and co-workers) and the publication of a revised species list of Aust. birds (Christidis & Boles 1994) since the preparation and publication of Volume 2, have brought much rearrangement. In this and subsequent volumes of HANZAB, taxonomy, nomenclature and arrangements of species follow Christidis & Boles (1994) (though they do not present subfamilial taxonomy). Their sequence of families of Charadriiformes occurring in HANZAB region is: Pedionomidae, Scolopacidae, Rostratulidae, Jacanidae, Chionidae, Burhinidae, Haematopodidae, Recurvirostridae, Charadriidae, Glareolidae and

Laridae. However, work on Volume 2 was too advanced to follow their sequence and taxonomy fully. The Scolopacidae are out of place in the arrangement of subfamilies in Volumes 2 and 3; other families follow the order of Christidis & Boles (1994).

### Plate 23

Oriental Pratincole *Glareola maldivarum* (page 366)

1 Adult breeding; 2 Adult non-breeding; 3 Juvenile;  
4, 5 Adult

Australian Pratincole *Stiltia isabella* (page 373)

6 Adult; 7 Downy young; 8 Juvenile;  
9 First immature non-breeding;  
10, 11 Adult

parental feeding than other Charadriiformes. Post-juvenile (first pre-basic) moult complete or partial, varying within and between families; moults of subadults complicated and vary between subfamilies (see subfamily accounts). Generally slow to mature, attaining adult plumage when 2–4 years old and first breeding at 2–4 years (smaller gulls and terns) to 4–9 years (many skuas and larger gulls and terns); some may breed in first year (e.g. *Sterna albifrons*).

Inhabit wide range of marine and freshwater habitats from Tropics to polar regions; many species strongly migratory, especially those breeding at high latitudes, e.g. South Polar Skua *Catharacta maccormicki* and Arctic Tern *Sterna paradisaea*, which migrate between polar regions. Most nest in terrestrial colonies near water (see subfamily accounts); some species highly pelagic in non-breeding season. Use wide range of foraging methods (see subfamilies; for discussion of feeding methods, see General Introduction).

See subfamily accounts for summaries of social organization and breeding.

## REFERENCES

- AOU. 1983. *Check-list of North American Birds*. Am. Orn. Union, Lawrence, Kansas.
- Campbell, B., & E. Lack. 1985. *A Dictionary of Birds*. Poyser, Calton, England.
- Christian, P.D., et al. 1992. *Aust. J. Zool.* 40: 225–33.
- Christidis, L., & W.E. Boles. 1994. *RAOU Monogr.* 2.
- Chu, P.C. 1995. *Condor* 97: 174–96.
- Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds*. Skarv Nature Pubs, Strandgården, Tisvildileje.
- Hackett, S.J. 1989. *Condor* 91: 73–90.
- Judin, K.A. 1965. *Fauna USSR, Aves. Ser. 1, 2, ns 91*. Acad. Sci., Moscow & Leningrad.
- Mayr, E., & D. Amadon. 1951. *Am. Mus. Novit.* 1496.
- Mickevich, M.F., & L.R. Parenti. 1980. *Syst. Zool.* 29: 108–13.
- Moynihan, M. 1959. *Am. Mus. Novit.* 1928.
- Schnell, G.D. 1970a. *Syst. Zool.* 19: 35–57.
- 1970b. *Syst. Zool.* 19: 264–302.
- Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds*. Yale University Press, New Haven.
- , & B.L. Monroe Jr. 1990. *Distribution and Taxonomy of Birds of the World*. Yale University Press, New Haven.
- , et al. 1988. *Auk* 105: 409–23.
- Strauch Jr, J.G. 1978. *Trans. zool. Soc. Lond.* 34: 263–345.
- Wetmore, A. 1960. *Smithson. Misc. Coll.* 139 (II): 1–37.
- Zusi, R.L. 1962. *Publ. Nuttall orn. Club* 3.

## Subfamily STERNINAE    terns and noddies

Cosmopolitan group of seabirds, with narrow pointed wings and long pointed bills, ranging in size from Little *Sterna albifrons* (20–28 cm) to Caspian Terns *Sterna caspia* (up to 55 cm). Mostly smaller, slimmer and longer-tailed than gulls (Larinae) and more aerial. About 42 species in six genera.

GENUS	NUMBER OF SPECIES
<i>Sterna</i>	Sea terns (including commic terns); c. 32 species; 17 in HANZAB region (15 breeding, 2 non-breeding migrants; 1 species not acceptably recorded)
<i>Chlidonias</i>	Marsh terns; 3 species; all recorded HANZAB region (1 breeding, 1 non-breeding, 1 accidental)
<i>Phaetusa</i>	Monotypic; Large-billed Tern <i>P. simplex</i> ; extralimital in South America; often combined in <i>Sterna</i>
<i>Anous</i>	Dark noddies; 3 species; all breed HANZAB region
<i>Procelsterna</i>	1 (possibly 2) species; Grey Ternlet <i>P. albivitta</i> breeds HANZAB region (second taxa extralimital)
<i>Gygis</i>	Monotypic; White Tern <i>G. alba</i> ; breed HANZAB region
<i>Larosterna</i>	Monotypic; Inca Tern <i>L. inca</i> ; extralimital in South America

Studies of osteology (Strauch 1978; Mickevich & Parenti 1980; Chu 1995), behaviour (Moynihan 1959), DNA–DNA hybridization (Sibley & Ahlquist 1990) and allozymes (Christian *et al.* 1992) have generally suggested that terns more closely related to gulls than to other Laridae; monophyly of the Sterninae appears not to be in doubt, and sometimes considered a full family (e.g. BWP).

Number of genera recognized varies. Moynihan (1959) recognized only three: *Sterna* (including *Chlidonias* and *Phaetusa*), *Larosterna*, and *Anous* (including *Procelsterna* and *Gygis*). Others have recognized as many as ten (e.g. Peters) or 12 (e.g. Wolters 1975) genera. Gull-billed Tern *S. nilotica* often placed in monotypic genus *Gelochelidon*; large terns with erectile crests (e.g. *S. bergii*, *S. bengalensis*) sometimes placed in *Thalasseus*; Caspian Tern *S. caspia* sometimes placed in monotypic genus *Hydroprogne*, or in *Thalasseus*. *Anous*, *Procelsterna* and *Gygis* sometimes treated as tribe Anousini (noddies). Our arrangement follows Christidis & Boles (1994) and Sibley & Monroe (1990), except that Black-fronted Tern *S. albostrigata* placed in *Sterna* rather than *Chlidonias* (following Mees 1977; Lalas & Heather 1980; NZCL; see that account). Monophyly of genus *Sterna* as recognized here has been challenged by electrophoretic study of Hackett (1989).

Body-form gull-like, but slimmer and more elongate than gulls except in largest species. Males usually slightly larger than females, especially in length and depth of bill. Necks short. Wings, long and pointed, narrower than in gulls; when wing folded, primaries project well beyond tertials (tips of 5–6 outer primaries usually exposed) and often beyond tip of tail. About 18–24 secondaries; ulnar part of wing shorter than in gulls. Flight musculature differs from gulls by lack of expansor secundarium (except in *Anous*). Tail, long in most species, with 12 rectrices: most have deeply forked tail, with t6 often elongated as tail-streamer; *Chlidonias* has short tail, only shallowly forked; tail of noddies forked, but with t3 or t4 longest in *Anous* and t5 longest in *Procelsterna* and *Gygis*. Bill, straight, with simple rhamphotheca and no cere; slender and rather long in most species, heavier in larger species, especially *Phaetusa*, short and thick in *S. nilotica*; tip pointed, not hooked. Legs, short or very short; tarsi rather weak; scutellate. Three front toes fully webbed, though webs deeply incised in *Chlidonias*; hindtoe reduced or vestigial, raised. Swim less readily than gulls, and have less well developed oil-gland (vestigial in *S. fuscata*). Supra-orbital salt-glands well developed. Down occurs on both pterygiae and apteria.

Sexes similar in plumage. Adult *Sterna* and *Phaetusa* usually uniform light grey above and white or pale grey below (with evanescent pink flush in some species), usually with contrasting black markings on head (often in form of cap) and tip of wing; some browner above (e.g. *S. fuscata*, *S. anaethetus*). *Chlidonias*, *Larosterna* and *Anous* mostly dark grey, dark brown or black above and below; *Procelsterna*, uniform ash-grey; *Gygis*, all white. Irides normally dark brown. Bill, legs and feet of most, yellow, orange, red or black. *Phaetusa*, *Chlidonias* and most *Sterna* show seasonal change in plumage: in non-breeding plumage, black caps reduced or flecked with white, many develop dark cubital bars, fork of tail usually less deep (and tail often slightly darker), underparts of grey-bellied species become paler, and bill and feet often become darker; *Chlidonias* also develop paler upperparts. No seasonal change in appearance of noddies. Adults typically have two moults per cycle: a complete post-breeding (pre-basic) moult to non-breeding plumage; and a partial pre-breeding (pre-alternate) moult to breeding plumage (which involves at least head, neck and some of body, and often all of body, tail and varying number of inner primaries). Primaries moult outwards. Moult of remiges, especially primaries, protracted in most; post-breeding (pre-basic) moult of primaries continues long after moult of body finished, and often overlaps with start of pre-breeding (pre-alternate) moult. Species moulting inner primaries in pre-breeding (pre-alternate) moult can thus have two concurrently active waves of moult in primaries. In some species (e.g. *S. albifrons* and some *Chlidonias*) there is often a third wave, as innermost primaries replaced a third time in a pre-supplemental moult. In two small pale tropical species (*Gygis alba* and *Sterna*

*sumatrana*), primaries replaced in staffelmauser, which is interrupted only when breeding; pre-alternate moults possibly lost in these species. Breeding and moult seldom overlap, except for some pre-basic moult of feathers of head when raising chicks (usually in larger or migratory species); in migratory species, most or all moult of remiges occurs in non-breeding areas and post-breeding moult (if started) is suspended during migration. In several species of oceanic terns nesting in Tropics, annual cycles last for less than 1 year, with duration between breeding events possibly dependent on time needed to complete moult (e.g. Ashmole 1962, 1963, 1968).

Downy young, precocial or semi-precocial; semi-nidifugous in most; nidicolous in *Gygis*, *Anous*. Natal down, ramose and woolly in most species, but long, straight, silky and very soft in *Chlidonias* (perhaps an adaptation to rather wet nesting sites). In some *Sterna* (e.g. *S. dougallii*), terminal barbs of down cling together to cause spiny appearance, especially on upperparts; down also very short in some (e.g. *S. albifrons*, *S. nereis*). Ground-colour of down ranges from white to grey or buff (rich orange-buff in *Chlidonias*), though dark, like adults, in some *Anous*. Dark markings on upperparts complex and diffuse: *Chlidonias* have bold black blotches; others varyingly streaked or speckled dark brown or black above, without distinct pattern except for three radiating lines on crown in many. Some species virtually unmarked above (e.g. *S. caspia*, *S. nilotica*). Some variation in colour and patterning of down (especially ground-colour) appears to be geographical (e.g. down of tropical populations of *S. dougallii* usually paler than in temperate populations) but also much individual variation, and siblings from the same clutch often look totally different (see Fjeldså 1977 for more information on downy young). Juvenile plumages typically differ from non-breeding adults in having buff or blackish tips or bars on much of upperparts and upperwing; tail generally darker than in adult, often with dark subterminal markings; many species have much individual variation in upperparts, and darkness of ground-colour and width of dark barring usually correlated. Juvenile plumages rather unusual in *S. virgata*, *S. vittata* and *S. fuscata*; see species accounts for details. In *Anous*, *Gygis* and *Procelsterna*, juvenile plumage similar to adult.

Sequence of moults from juvenile to adult plumage, complex. When recognizable traces of juvenile plumage have been lost, distinction of immatures from adults depends mainly on moult and wear of primaries. However, this of little use for ageing species in which timing of breeding and moulting vary (a frequent occurrence in Tropics) and subadult moults of such species (including all noddies) poorly known. Following generalizations based on species of *Sterna* and *Chlidonias* with regular cycles. **POST-JUVENILE (FIRST PRE-BASIC) MOULT** usually complete, with head and body finished several months before last outer primaries; in some species, birds can arrest moult when a few very worn outer primaries remain. In several species of medium-sized *Sterna* from s. hemisphere (*striata*, *albobristata*, *vittata* and *virgata*), post-juvenile moult appears to be partial, moulting almost no remiges or rectrices (though interpretation complicated because, unlike most juvenile terns, first post-breeding [second pre-basic] moult of head and body coincides with first moult of primaries, much as in typical gulls [D.J. James]); these species (and possibly *S. hirundinacea*) have several other unusual features in common, including heavily marked juvenile plumages, little sexual dimorphism in length of wing, and only one moult of primaries and (apparently) rectrices per cycle. They may represent a radiation from a single s. hemisphere ancestor (D.J. James). Whether first pre-basic moult partial or complete, most terns superficially resemble adult non-breeding when 3–7 months old, except for retained juvenile remiges (which are still moulting). When 9–12 months old, at least some perform partial **FIRST PRE-BREEDING (FIRST PRE-ALTERNATE) MOULT**, often starting before post-juvenile moult finished; some attain traces of breeding plumage (especially on crown and cubital bar) but in most there is probably no change in appearance. Resultant first immature non-breeding (first alternate) plumage superficially like adult non-breeding and, in species with regular cycles, held when adults in full breeding plumage.<sup>1</sup> When c. 1 year old, complete **FIRST IMMATURE POST-BREEDING (SECOND PRE-BASIC) MOULT** brings on plumage almost identical to adult non-breeding; this retained for much of second year, so most immatures retain non-breeding appearance from c. 5 months to c. 21 months old. Partial **SECOND PRE-BREEDING (SECOND PRE-ALTERNATE) MOULT** near end of second year is first moult to bring on extensive breeding plumage. In many species, second immature breeding plumage may differ from adult breeding in having a few non-breeding-like feathers in crown, cubital bar, tail or underparts; however, reliability of these ageing characters undermined in some species by similar variation in very small number of adults. Subsequent moults, as adults.

Mostly marine, inshore; some frequent both littoral and freshwater habitats; some markedly pelagic. Carnivorous; some only or mainly take fish (e.g. Black-naped Tern *S. sumatrana*, White-fronted Tern *S. striata*); other HANZAB species take mixture of fish, molluscs, crustaceans and insects; some freshwater species also take small vertebrates, such as mice or frogs (e.g. Whiskered Tern *C. hybridus* and Gull-billed Tern *S. nilotica*). Mostly diurnal but some nocturnal or crepuscular. Forage singly, in small groups or in mixed species feeding flocks, usually with other terns or seabirds, such as shearwaters. Feed mainly by surface plunging, occasionally shallow plunging; and by dipping (contact and non-contact). Also feed by hawking for insects over land and water; gleaning food while walking on ground or in shallow water; and kleptoparasitism.

<sup>1</sup> In Arctic Terns, the first alternate plumage was once mistaken as a separate species and named *Sterna portlandica* (Ridgway 1874), and the second alternate plumage was mistaken as another, *Sterna pikei* (Lawrence 1853). These taxonomic treatments have long since been discarded, but the terms 'portlandica plumage' and 'pikei plumage' still confusingly and incorrectly used for homologous plumages in many terns.

Highly gregarious when feeding, roosting and breeding, and will mob predators at colonies. Monogamous, with pair-bonds tending to persist from year to year. Birds may breed as early as 1 year old, but usually not till 3–4 and even older. Can live for many years. Normally breed in colonies, which can number up to tens of thousands. Nesting densities vary with species and habitat, and in large colonies of some *Sterna*, distances between nests can be a body-length. Nesting territories used for courtship and pair-formation, courtship feeding, copulation, and nesting. Fidelity to nesting site between years high in some species, though other species move between colonies or shift site of colonies altogether (Campbell & Lack 1985). At colonies, social flights, called MASS FLIGHTS, DREADS, PANICS, or UPFLIGHTS, common. In these displays, some or all members of a colony take flight and fly round in dense flock. Many authors use the terms interchangeably. Others distinguish between Mass Flights and Dreads: In Dreads, birds take off and fly low over colony for some distance without calling, then fly upwards calling loudly; Dreads an escape response but may also be used to help synchronize breeding. In Mass Flights, all birds take off and fly upwards, calling loudly from outset; Mass Flights most common before laying and are used to help synchronize breeding cycles of individuals; resurgence of Mass Flights occurs when chicks being fed, mostly by non-breeding birds visiting colony, at least some of which are preparing to breed in the next breeding season (K. Hulsman). The distinction is often not clear in published descriptions of flock behaviour. Vocal at breeding colonies; calls raucous.

In *Sterna* and allied genera, displays usually elaborate and similar between species. Aerial flights and some ground displays persist after laying. In GROUND DISPLAYS, which often involve more than two birds, birds drop wings, raise tails and stretch necks upwards. Aerial displays occur in and round colonies. In HIGH FLIGHTS, several birds ascend rapidly to 100 m or more, with some birds displaying as they descend. Zigzagging flights common and especially spectacular in Crested Tern, even after nesting has finished (Gibson 1956). A male carrying a fish will execute noisy LOW FLIGHT through colony, which often stimulates others to join in. FISH-OFFERING CEREMONIES involve one bird flying round, calling loudly, usually with fish held crosswise in bill; usually, another joins it, flying in front of first. Fish not transferred on wing, but may be passed on ground, accompanied by strutting.

Noddies (*Anous*, *Procelsterna* and *Gygis*) have different displays to sea terns. Similarities include ground displays before and during incubation, which involve birds dropping wings so that tips on or close to ground. In courtship display at nest-site, male bobs head slightly and caresses head and neck of female with bill; male courtship-feeds female, and birds call and touch bills. In aggressive territorial displays, male raises feathers of crown slightly, gives rattling call, then thrusts stiffened neck forward and bows. In all displays, orange tongue, pale crown and markings round eyes prominent (Woodward 1972).

Within Sterninae, both sexes share nest duties. Chicks semi-precocial and, if undisturbed, semi-nidifugous (most species) or nidicolous (*Anous*, *Gygis*); older chicks occasionally form crèches in some *Sterna*. Food given in bill (most species) or by regurgitation (e.g. *S. fuscata*, *Anous*). Parental feeding continues after fledging, sometimes for several months and, sometimes, after dispersal from colonies (Campbell & Lack 1985; BWP).

Breeding seasonal, though some tropical terns, notably Bridled *S. anaethetus* and Sooty *S. fuscata* Terns, breed at sub-annual intervals depending on local conditions; at some sites, breeding of population may be continuous (King & Buckley 1985; King *et al.* 1992; BWP). Usually breed in colonies on offshore islands or on headlands; also on or round terrestrial wetlands or in coastal habitats, such as sand dunes, beaches and on islands and sandspits in estuaries; some species nest on cliffs (e.g. Grey Ternlet *P. albivitta*); Black-fronted Terns nest in shingle beds in streams; Whiskered Terns in vegetation in freshwater swamps; occasionally nest on man-made structures, such as jetties and wrecked ships (HASB; Aust. NRS). Will nest with other species of terns. Ground-nesting birds make unlined or poorly lined scrape in sand or gravel, sometimes under vegetation or in crevice of rock; most noddies nest in trees and bushes, and build bulky nests out of plant material, though many Common Noddies *A. stolidus* nest on ground; Whiskered Terns build mounds or platforms of vegetation; White Terns make no nest, laying egg on bare branch or leaf of a tree (Fjeldså 1977; HASB; Aust. NRS). Ground-colour of eggs varies from cream or stone-grey to greenish stone, buff or light brown, with markings of black or dark brown, occasionally dark purple (HASB). Clutch-size, 1–3; most species breeding temperate zones average two eggs per clutch, most in tropical areas only one. Incubation period ranges from 19 to 36 days; species that lay 2–3 eggs per clutch incubate for shorter periods, mostly between 19 and 23 days, while those that usually lay one egg incubate for longer, from 28 to 36 days. Both sexes incubate. Adults defecate away from nest. Both sexes feed young, mostly bill to bill or by dropping item beside chick, though noddies, *Procelsterna* and some tropical *Sterna* fed by regurgitation. Young of ground-nesting species leave nest within 1 week of hatching but may remain near nest for a few more days; usually seek shelter in nearby cover, though some species form crèches (Hulsman 1977; HASB); young of tree-nesting species usually remain in nest till able to fly (but see *Gygis alba*). Most species dependent on parents for food for up to 4 months after fledging. Age of first breeding, usually 3–4 years, some species at 2 years (BWP).

#### REFERENCES

- Ashmole, N.P. 1962. *Ibis* 103b: 235–73.  
 — 1963. *Postilla* 76.  
 — 1968. *Condor* 70: 35–55.

- Campbell, B., & E. Lack. 1984. *A Dictionary of Birds*. Poyser, Calton, England.  
 Christian, P.D., *et al.* 1992. *Aust. J. Zool.* 40: 291–302.  
 Christidis, L., & W.E. Boles. 1994. *RAOU Monogr.* 2.

576 Sterninae

- Chu, P.C. 1995. *Condor* 97: 174–96.
- Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds*. Skarv Nature Publs, Strandgården, Tisvildileje.
- Gibson, J.D. 1956. *Emu* 56: 131–2.
- Hackett, S.J. 1989. *Condor* 91: 73–90.
- Hulsman, K. 1977. *Emu* 77: 49–60.
- King, B.R., & R.C. Buckley. 1985. *Corella* 10: 73–7.
- , et al. 1992. *Emu* 93: 1–10.
- Lalas, C., & B.D. Heather. 1980. *Notornis* 27: 45–68.
- Lawrence, G.N. 1853. *Ann. Lyceum Nat. Hist. New York* 6: 1–4.
- Mees, G.F. 1977. *Zool. Verh.* 157: 1–64.
- Mickevich, M.F., & L.R. Parenti. 1980. *Syst. Zool.* 29: 108–13.
- Moynihan, M. 1959. *Am. Mus. Novit.* 1927.
- Ridgway, R. 1874. *Am. Nat.* 8: 433.
- Sibley, C.G., & J.E. Ahlquist. 1990. *Phylogeny and Classification of Birds*. Yale University Press, New Haven.
- , & B.L. Monroe Jr. 1990. *Distribution and Taxonomy of Birds of the World*. Yale University Press, New Haven.
- Strauch, J.G. Jr. 1978. *Trans. zool. Soc. Lond.* 34: 263–345.
- Wolters, H.E. 1975. *Die Vogelarten der Erde. 1*. Hamburg.
- Woodward, P.W. 1972. *Atoll Res. Bull.* 164: 1–318.



*Chlidonias hybridus* Whiskered Tern

COLOUR PLATES FACING PAGES 704 &amp; 705

*Sterna hybrida* Pallas, 1811, *Zoogr. Rosso-Asiat.* 2: 338 —southern Volga and Sarpa Lake, south-eastern Russia.

Generic name formed from a misspelling of Greek χελιδόνιος, swallow-like, χελιδών, a swallow. Pallas used *hybrida* (Latin *hybridus*, hybrid) for this bird because he considered that its characters showed it to be a hybrid between Black *Chlidonias niger* and Common *Sterna hirundo* Terns

OTHER ENGLISH NAMES Marsh Tern, Black-fronted Tern.

**POLYTYPIC** Subspecies *javanicus* (Horsfield, 1821) breeds Aust. Extralimittally: Nominate *hybridus* breeds North Africa, Europe, Middle East, n. India and s. Siberia, E to Ussuriland, China and Assam (India); subspecies *delalandii* (Mathews, 1912) breeds s. and e. Africa and Madagascar.

**FIELD IDENTIFICATION** Length 23–25 cm; wingspan 74–78 cm; weight 80 g. Largest marsh tern (*Chlidonias*), with more dagger-shaped bill than congeners. Small, tubby marsh tern, with short slightly forked tail, appearing square-cut at tip when spread. Slightly bigger and bulkier than White-winged Black *C. leucopterus* and Black *C. niger* Terns, with slightly longer and more uniformly broad wings and slightly deeper tail-fork. Smaller, tubbier and more compact than sea terns *Sterna*, with shorter wings and shorter, less deeply forked tail. Plumages somewhat like those of *Sterna*. Adult in breeding plumage, distinctive: pale grey above, with neat black cap, and mostly grey underbody. Non-breeding plumages, pale grey above and white below, with white head finely streaked black on hindcrown and distinctive black band from eye to nape. Juvenile has dusky cap and distinctive variegated buff-and-black saddle. Sexes alike, though male has heavier bill. Marked seasonal variation. Juvenile and immatures separable.

**Description Adult breeding** Forehead, crown and nape, black, forming neat cap, bordered below by white cheek-stripe; cap becomes finely spotted with white during moult. Rest of upperparts, pale grey, with diffuse narrow dusky trailing-edge to outer primaries; some have slightly darker secondary bar and slight contrast between dusky-grey outer primaries and newer pale-grey inner primaries. Chin and throat, light grey or white, grading to dark-grey belly and flanks (usually blackest on centre of belly); white vent and undertail-coverts sharply demarcated from rest of underbody. Underwing, white, with diffuse narrow grey trailing-edge to secondaries and blackish trailing-edge to outer 5–8 primaries. Bill, dark red. Iris, dark brown. Legs and feet, red to dark red. **Adult non-breeding** Differ from adult breeding by: Head and neck, white, with small black patch in front of eye and black band running from eye round nape and extending broadly down nape, nearly joining mantle; crown, finely streaked darker, grading to black of nape. In fresh plumage, upperwing uniform grey apart from slightly darker secondaries and alula; some have faint narrow dark cubital bar; secondaries, alula and trailing-edge of outer primaries become darker with wear. Underbody, white; some have indistinct narrow grey patch extending from mantle onto sides of upper breast. Bill, black, with varying dark red-brown tinge at base. Legs and feet, black, with red tinge. **Juvenile** Similar to adult non-breeding, differing by: Pattern of head similar but forehead and anterior lores washed buff or brown in fresh plumage; black patch in front of eye, larger; black extends lower on ear-coverts; and whole of crown, often darker, brown; overall, appears to have larger darker cap but with paler forehead and, often, pale supercilium and some white

streaking. Saddle and tertials, buff, with irregular broad black bars, appearing strongly variegated; in flight, contrastingly darker than pale-grey upperwings. Rump and tail, pale grey, with narrow dark-brown terminal band and white sides to tail. Upperwing: pale grey, with darker secondary bar, patch at alula and trailing-edge to outer primaries; some have narrow dark cubital bar; central secondary coverts have buff tips and varying dark bands. Underbody, white, often with diffuse narrow buff or brown patch extending from mantle onto sides of upper breast in fresh plumage, and some have faint buff or brown smudging on foreflanks. Bill, black, tinged dull red-brown at base in some. Legs and feet, orange-red to brown-red. **Transition to first immature** Post-juvenile moult complete and protracted, gradually attaining non-breeding plumage like that of adult. In early stages, acquire head and saddle as adult non-breeding, but retain juvenile tertials, wing and tail; before start of wing-moult, central secondary coverts may be worn, faded and paler, contrasting strongly with darker leading-edge and dusky remiges. Later, appear similar to moulting non-breeding adult, showing contrasting worn dark secondaries and outer primaries. **First immature (non-breeding and breeding)** Inseparable from adult non-breeding once all trace of dark juvenile tail-band lost. Some in first immature breeding acquire a few scattered grey feathers on belly.

**Similar species** In non-breeding and juvenile plumages, often confused with **White-winged Black Tern**, which differs by: slightly smaller, slimmer and more compact, with slightly shorter, narrower wings; smaller more rounded head; slightly shorter and less deeply forked tail; slightly shorter and usually much finer bill (though some overlap: male Whiskered Terns have slightly longer and heavier bills than any White-winged Black; female Whiskered have finer bill, similar to that of White-winged Black); and proportionately slightly shorter legs. Flight slightly lighter and more buoyant, with slightly quicker, shallower wing-beats. Flight calls also quieter, less hoarse and rasping. In **ADULT NON-BREEDING and IMMATURE PLUMAGES**, White-winged Black differs by: (1) generally darker and mottled or solid black crown; dark band or spot on ear-coverts extends farther below level of eye; and white on sides of head extends farther up behind dark ear-coverts; from behind, black nape extends narrowly from upper nape onto mid-nape then broadens into patch, leaving distinct white collar (on Whiskered, broader area of black on nape, almost reaching mantle, with, at best, only narrow pale collar); (2) upperparts, darker grey, with contrasting darker upper edge to mantle and prominent dark cubital bar; in flight, also differ by: (3) moulting birds have much stronger contrast on upperwing

between older darker remiges and newer paler ones; (4) paler white or grey-white rump and uppertail-coverts, normally contrasting with saddle and tail; and (5) more contrasting white sides to tail. JUVENILE best distinguished by: (1) neater, more black-and-white pattern of head, with white on sides of neck not reaching so high behind ear-coverts, narrower dark patch on nape, and distinct white collar; (2) more uniform and generally darker black-brown saddle, contrasting more with pale wings and rump; (3) white rump and grey-white uppertail-coverts, contrasting with darker saddle and tail; (4) more contrasting white sides to tail; and (5) slightly darker grey upperwing, usually with broader darker cubital bar (often faint or lacking on Whiskered, though some have narrow dark bar similar to poorly marked White-winged Black). In non-breeding and juvenile plumages, possibly also confused with **Black Tern** (q.v.). For further details of identification of marsh terns, see Alstrom (1989) and Olsen & Larsson (1995). Vagrants to NZ could be confused with **Black-fronted Tern** *Sterna albostrigata* (q.v.). Sometimes confused with **Arctic** *Sterna paradisaea* and **Common** *S. hirundo* Terns. Both Common and Arctic Terns larger and slimmer, with proportionately smaller head; longer, narrower, more angular and pointed wings; much longer and more deeply forked tail; finer (and, in Common, longer) bill; and much shorter legs; look more attenuated at rest and in flight. In all plumages, Arctic easily distinguished by distinct white collar; white rump and tail; contrasting dark sides to tail; prominent neat tapering black line along trailing-edge of underside of primaries; and strongly translucent remiges. In adult breeding plumage, Arctic superficially similar but underbody paler grey and more uniform (not darkening on belly as on Whiskered); and bill brighter red. Common differs by: In all plumages, upperparts are slightly darker grey, with distinct white collar. In adult breeding plumage, underbody, rump and tail differ in same way as for Arctic; bill, normally black, though some have bright-red bill with black tip. More alike in juvenile and non-breeding plumages, as rump and tail are pale grey (though still noticeably paler than rest of upperparts and with contrasting dark sides); upperwing has dark cubital bar and, when moulting, dark secondary bar and wedge on outer primaries; also, black of nape extends farther forwards onto crown, giving more extensive dark half-hood.

Gregarious; usually in small to large flocks when feeding, roosting or moving; sometimes in hundreds. Often associate with other terns, especially White-winged Black Tern. Inhabit wide variety of freshwater and brackish wetlands, both coastal and inland. Flight varies: at times, much as other marsh terns, though slower; at other times, more like medium-sized *Sterna*, with more regular and deeper wing-beats and more direct track than other marsh terns. Feeding flight similar to that of other marsh terns: patrol 5–10 m above water, flying into wind on steady direct track, with regular purposeful wing-beats, dipping to snatch prey from surface; also hawk for insects over swamps, damp grass or croplands; unlike other marsh terns, often plunge-dive for fish. Carriage and gait as other marsh terns, though stand taller. Calls harsher than those of other marsh terns, especially when breeding; normal flight call hoarse rasping *eirchk*, *kreerp* or *cherk*, recalling call of Black-winged Stilt *Himantopus himantopus*.

**HABITAT** Prefer shallow terrestrial freshwater wetlands, either permanent and ephemeral, including lakes, swamps, billabongs, river pools, reservoirs, large dams, sewage ponds, flooded saltmarsh and farmland; often round floodwaters. Usually in wetlands with much submerged and emergent vegeta-

tion, such as grass, sedges, reeds and rushes; occasionally also in swamps of lignum, bluebush, canegrass or saltmarsh. Less often on brackish waters (Morgan 1931; Watson 1955; Bourke 1956; Portbury & Buntine 1961; McEvey 1965; Badman 1981; Fjeldså 1985; Bamford 1988; Dostine & Morton 1989; Templeton 1992). Rarely, on saline wetlands, including saltponds, hypersaline lakes and saline waterholes (Watson 1955; Crawford 1975; Badman 1979, 1989; Gibson 1986; Saunders *et al.* 1987; Taylor 1987; Bellchambers & Carpenter 1990). Occasionally in sheltered coastal waters, such as harbours, estuaries, coastal lagoons, mangrove creeks and channels between islands (Crawford 1977; Storr 1977; Roberts 1979; Taylor 1987; Hembrow 1988; Storr & Johnstone 1988; Stove 1994; HASB); probably only at sea during migration (Vic. Atlas). In arid inland mostly occur after heavy rain or floods (Serventy & Whittell 1976; HASB), and may frequent flooded claypans and bore-drains (Parker 1969; Serventy & Whittell 1976; Storr 1977, 1984, 1985a,b; Gibson 1986). Occasionally seen over dry terrestrial habitats, such as saltbush plains and farm paddocks (Bourke 1956; Hobbs 1976). Present in hilly country in n. Kimberley Div. (Storr 1980).

Often breed in temporarily flooded terrestrial wetlands and other inundated flats, including claypans and farmland, in water up to 1 m deep. Usually among inundated vegetation, such as lignum, canegrass, saltmarsh or reeds; often among floating water-ribbon. Nests floating, attached to vegetation, on small islets or on submerged or partly submerged bushes (Morgan 1931; Smith & O'Connor 1955; Watson 1955; Bourke 1956; Portbury & Buntine 1961; Fuller 1963; Disher 1966; Ford 1969; Serventy & Whittell 1976; Badman 1981; Storr 1985a; Aust. NRS).

Usually forage on terrestrial wetlands; in permanent swamps or floodwaters, with vegetated margins or emergent aquatic plants, including grass, sedges, reeds and rushes (Bourke 1956; Portbury & Buntine 1961; Dostine & Morton 1989); prefer wetlands without floating vegetation (Crawford 1977), though occasionally forage there (Dostine & Morton 1989). Forage aerially over wetlands, and over farmland, including rice paddies, dry paddocks, and dry sedge-plains; also feed from surface of water, just below surface of water, and glean from emergent vegetation (Bourke 1956; Hobbs 1976; Crawford 1977; Dostine & Morton 1989; HASB). Will also feed on ground, in farmland, mainly during plagues of mice, locusts, caterpillars, and so on. Rarely, feed on hypersaline lakes (Saunders *et al.* 1987); sometimes in harbours or over seawater on calm days (Crawford 1977; HASB).

Roost or loaf in wetlands, on muddy spits and banks, among dense reeds; also perch on branches of dead trees, logs or fence posts. During breeding season, roost on floating nesting platforms (Bourke 1956; Saunders *et al.* 1987).

**DISTRIBUTION AND POPULATION** Breed Africa, s. Europe E to Caspian Sea, n. India, e. Asia and Aust. (see summary in Mees 1977). Breed s. and se. Africa, from South Africa, N to se. Angola, s. Zaire, s. Malawi and Mozambique; also Madagascar and through much of Tanzania and s. Kenya. In n. Africa and s. Europe, scattered breeding in Morocco, Algeria and Tunisia (Urban *et al.* 1986) and from Iberian Pen. N to France (with sporadic breeding in Low Countries and Germany), E through n. Italy, Austria, to Hungary and Romania, and SE to n. Greece and Turkey; also Iraq. Farther E, breed ne. shores Black Sea, n. and s. shores of Caspian Sea, and lower reaches of Volga R., extending E to tributaries of Aral Sea; also isolated site at head of Irtysh R. (Dement'ev & Gladkov 1951;

BWP). Breed India and Bangladesh, in valleys of Ganges and Brahmaputra Rs (Ali & Ripley 1969). In e. Russia, breed L. Khanka, N of Vladivostok (Mees 1977). Breeding status in e. Asia not clear; de Schauensee (1984) listed breeding distribution in China extending from Heilungkiang in NE, inland to Ningsia Province, along upper Hwang Ho, and S in e. and central China to Yunnan and Kwangtung in SE, and Taiwan. Mees (1977) found only one authentic breeding record in China, but stated that 'no doubt ... the species breeds much more widely in China'. Claimed breeding in Indonesia in nineteenth century said to be Black-naped Terns *Sterna sumatrana* (White & Bruce 1986). During non-breeding period: occur s. Africa; central Africa, mainly N of Equator and S of Sahara Desert, extending N along valley of Nile R. to s. Mediterranean Sea; also se. Iraq; throughout Indian subcontinent; along valley of Irrawaddy R., S to Gulf of Martaban; n. Gulf of Thailand, extending E through Indonesia to New Guinea, S to Aust. (rarely NZ) and N through Philippines to e. China and inland to Mongolia (Ali & Ripley 1969; Mees 1977; de Schauensee 1984; Urban *et al.* 1986; BWP). Single record in North America, at Delaware Bay, ne. USA, mid-1993 (Austin 1993).

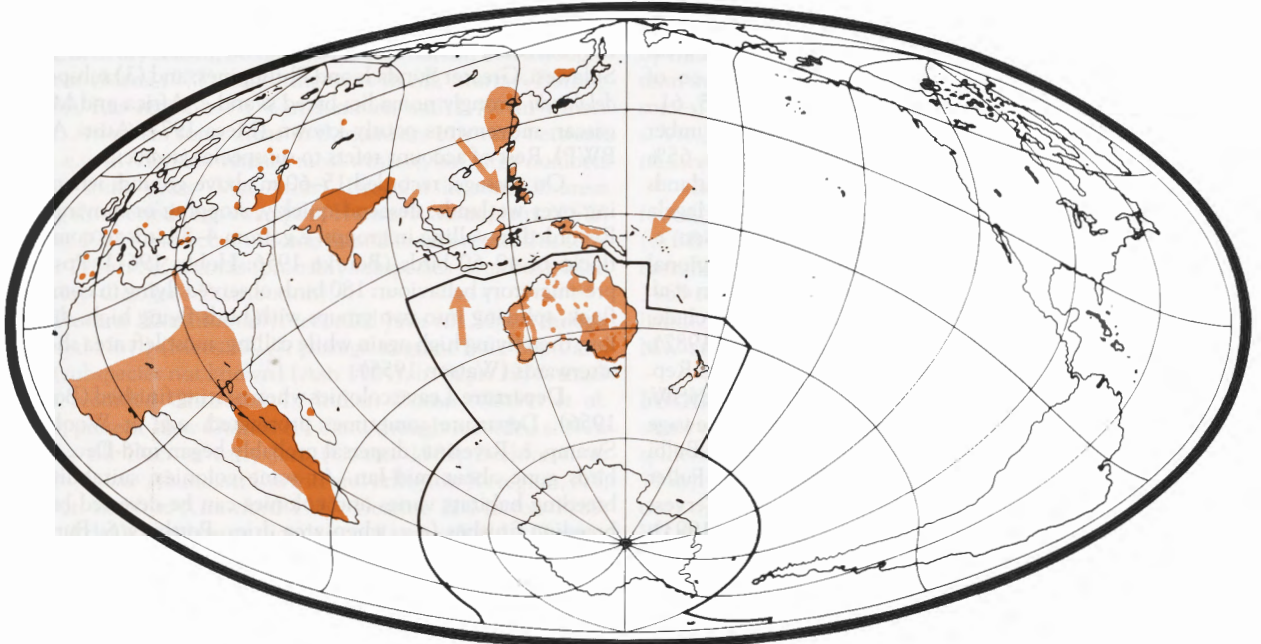
**Aust.** Scattered in most regions of mainland except for arid zones of w. SA, e. WA and sw. NT (Aust. Atlas). **Qld** Scattered records in Gulf Country and w. C. York Pen., but not recorded Torres Str. or e., central and s. C. York Pen. In e. Qld, S from Cairns to NSW border, extending W to area bounded by Dirranbandi, Tambo and Mt Isa; scattered records farther W, from Dynevor Downs and Thargomindah, NW to Glenormiston Stn (Aust. Atlas). **NSW** Widespread in all regions. **Vic.** Few records in Gippsland and NE, but widespread elsewhere in W of State (Vic. Atlas). **Tas.** Vagrant (singles unless stated): near Ouse, 12–13 Sept. 1967; said to have returned in July 1969 (Wall 1970); C. Portland, 14 Apr. 1968 (Green 1989); Flinders I.: Cameron Inlet, 20 Nov. 1981 (Fletcher *et al.* 1983), Logan's Lagoon, 26 Aug. 1984 (Tas. Bird Rep. 14), nine, Focchow Inlet, 11 Sept. 1984 (Tas. Bird Rep. 14); Mortimer Bay–South Arm Bay, 5 Feb. 1989 (Tas. Bird Rep. 19). **SA** Throughout E of State, E of line from Oolgawa

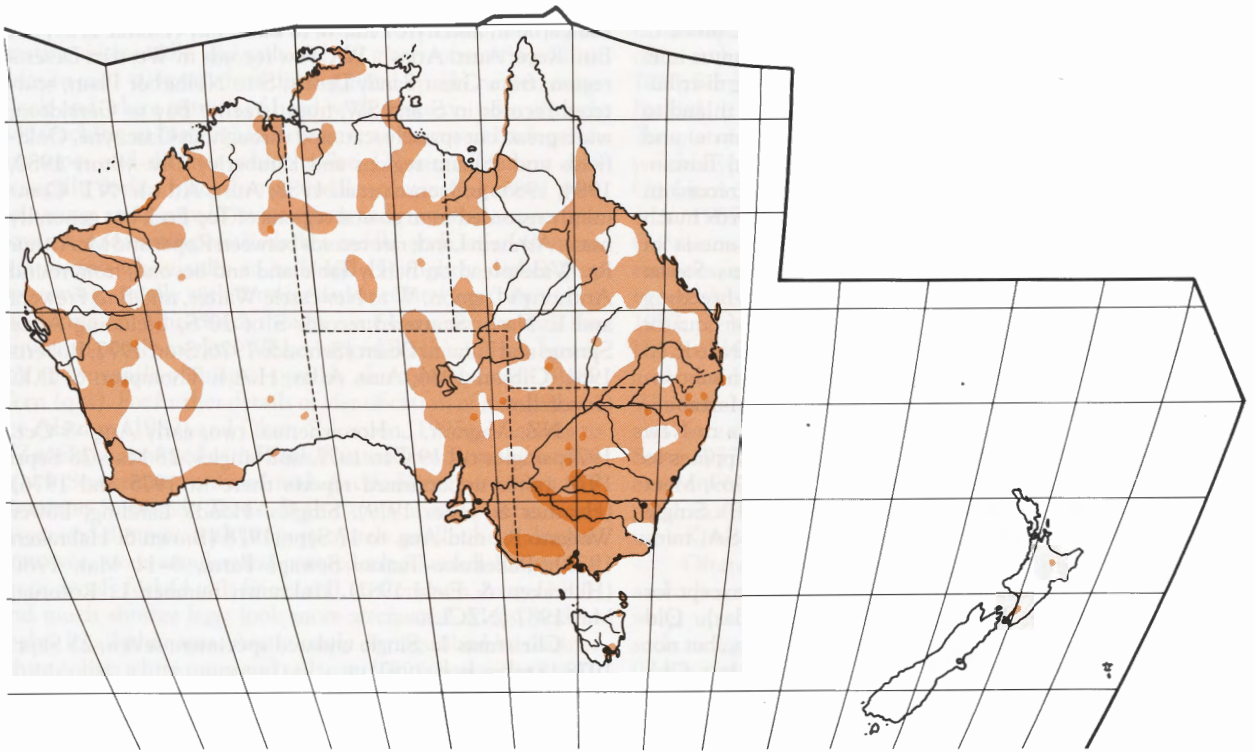
Waterhole (95 km NNE of Oodnadatta) to Port Augusta and Kangaroo I.; also Eyre Pen., W to Baird Bay (Baxter 1989; SA Bird Reps; Aust. Atlas). **WA** Few records in Western Deserts region, from Great Sandy Desert, S to Nullarbor Plain; scattered records in S and SW, from Israelite Bay to Geraldton; widespread but sparsely scattered throughout Gascoyne, Goldfields and Pilbara regions and Kimberley Div. (Storr 1980, 1984, 1985a,b; Jaensch *et al.* 1988; Aust. Atlas). **NT** Commonly recorded in n. coastal regions of Top End, but generally not e. Arnhem Land; rare records between Roper and McArthur Rs. Widespread on Barkly Tableland and beyond, from round Anthony's Lagoon, W to Newcastle Waters, and S to Frewera and L. Nash. Scattered records S of 20°S, including Alice Springs and Tanami Desert (Schodde 1976; Storr 1977; Roberts 1981; Gibson 1986; Aust. Atlas; H.A.F. Thompson & D.K. Goodfellow).

**NZ** Vagrant. L. Horowhenua: two, early Aug.–5 Oct. 1977, singles till 19 Oct. 1977, and singles, 28 May–28 Sept. 1978 (after unconfirmed reports there in 1975 and 1976) (Heather & Jones 1979). Singles: Hood's Landing, Lower Waikato R., mid-Aug. to 17 Sept. 1978 (Brown & Habraken 1979); Pukekoke–Tuakau Sewage Farm, 8–11 Mar. 1980 (Habraken & Field 1982). Unknown number, L. Rotorua, May 1987 (NZCL).

**Christmas I.** Single undated specimen; seven, 23 Sept. 1978 (Stokes *et al.* 1987).

**Breeding** Breed at scattered sites, mainly in se. Aust. **Qld** At L. Bullawarra, in SW, 1956 (Nielsen 1963). No breeding records in Aust. NRS or during Aust. Atlas. **NSW** A few sites on Tablelands of Great Divide or farther E, including Casino, Glen Innes, Grafton, Uralla, Nowra and L. Bathurst (Lamm 1965; Gosper 1973; Morris *et al.* 1981; NSW Bird Rep. 1984). Widespread breeding in Murray–Darling Basin (NSW Bird Reps; Aust. NRS; Aust. Atlas). **Vic.** Round Murray R. and farther S in Central and Western Districts (Vic. Bird Reps; Aust. NRS; Aust. Atlas). **SA** Three breeding records: near Lucindale, Mt Charles (W of Keith) and L. Watherston (Aust. NRS; Aust. Atlas). Historical record from 'Broken Swamp', W of L. Callabonna, Jan. 1931 (Morgan 1931). **WA** Scattered





records from Yalgoo and Thunderra Stn, NE to Ls Anneen and Nabberu (Storr 1985a,b; Anon. 1992, 1993); also Anna Plains (Anon. 1994), Sandfire Flat (Kolichis 1992) and L. Gregory (Jaensch & Vervest 1990); probably breed in more areas than these scattered records suggest, e.g. may have bred at C. Arid (Vervest 1989) and Northam (Masters & Milhinch 1974). NT Unconfirmed report from Brunette Ck (Storr 1977).

**Populations** Indices of relative abundance from annual aerial surveys (transect counts) of wetlands in c. 12% of land area of e. Aust., Oct. 1983–93 (Braithwaite *et al.* 1985a,b, 1986, 1987; Kingsford *et al.* 1988, 1989, 1990, 1991, 1992, 1993, 1994) were: 32,571; 4690; 14,830; 6020; 8906; 15,668; 2234; 1346; 19,463; 2526; 6039 respectively. Important areas from these surveys were: floodplains at confluence of Murrumbidgee and Lachlan Rs, central s. NSW (1985, 61–80% of total number counted; 1986, 41–60% of total number counted; 1988, 81–100% of total number counted; 1993, 65% of number counted). In sw. WA, recorded on 31 of 197 wetlands surveyed 1981–85 (Jaensch *et al.* 1988). In NT, on Magela Floodplain, mean density for ground counts in dry season, c. 30/km<sup>2</sup> (Dostine & Morton 1989) and maximum regional population for Alligator R. Region, 50,000 birds (Morton *et al.* 1993). Some localities where >700 birds recorded include: Cullen's L., Vic., c. 6000, Nov. 1987 (Vic. Bird Rep. 1987); Fivebough Swamp, NSW, c. 3000, Jan. 1987 (NSW Bird Rep. 1987); Mirrool Ck (between Gunbar and Griffith), NSW, 2000+, Oct. 1984 (NSW Bird Rep. 1984); Werribee Sewage Farm, Vic., 2000+, Dec. 1982 (Vic. Bird Rep. 1982); Bulbi Plain, Great Sandy Desert, WA, c. 2000, 1980 (Start & Fuller 1983); L. Gregory, WA, 1996, Aug. 1986 (Jaensch & Vervest 1990); Narran L., NSW, 1200, Nov. 1978 (Brooker 1993); Hinton–Seaham–Paterson, NSW, >1000, Dec. 1959 (Hobbs & Kaveney 1962); Anna Plains Stn, WA, 1000+, Mar. 1994 (Anon. 1994); Minagoona L., SA, Mar. c. 1000, 1979 (Badman 1981); Sandfire Flat, WA, 1000, Mar. 1980 (Kolichis 1992);

Peel Inlet, WA, 827, Sept. 1983 (Anon. 1983); Reedy L.–Hospital Swamp, Vic., 700, Jan. 1985 (Vic. Bird Rep. 1985).

**MOVEMENTS** Migratory and dispersive. Three subspecies, one recorded HANZAB region: (1) subspecies *javanicus* mostly migratory; mainly breed s. Aust.; most move N and NW to non-breeding areas in n. Aust., New Guinea, Moluccas, Celebes, Java and Borneo; (2) nominate *hybridus* migratory; breed North Africa, Europe, Middle East, n. India and s. Siberia E to Ussuriland, China and Assam (India) and move to non-breeding areas in Africa, Iran, Pakistan, Sudan, Ethiopia, India and Sri Lanka; birds from China and e. Asia move to non-breeding areas in Sri Lanka, se. Asia, Borneo, Java, Sulawesi, Greater Sunda Is and Philippines; and (3) subspecies *delalandii* strongly nomadic; breed s. and e. Africa and Madagascar; movements poorly known (Mees 1977; Aust. Atlas; BWP). Rest of account refers to subspecies *javanicus*.

On passage, recorded 15–60 m above ground; when flying over wetlands, descend quickly, stopping or moving on. Recorded travelling in groups, e.g. from 4–8 birds to compact flocks of 40–60 birds (Bourke 1956; Hobbs 1961). Possible pre-migratory behaviour: 180 birds observed flying in compact flock, splitting into two groups with birds flying high, diving low, then flying high again while calling; most left area shortly afterwards (Watson 1955).

**Departure** Leave colonies when nesting finished (Bourke 1956). Departure sometimes protracted, e.g. at Woolner's Swamp, e. Riverina, dispersal probably began mid-Dec., with birds gone about mid-Jan. At some colonies, suitability of breeding habitats varies and colonies can be deserted before breeding finishes (e.g. when area dries, Portbury & Buntine 1961) or departure can be rapid (e.g. 13 days after colony of c. 4000 birds located, water almost gone and only c. 12 birds remained, Bourke 1956). In Ivanhoe district, NSW, few seen after Mar.; leave even if food plentiful (such as plague of mice).

if breeding in sw. NSW, leave Apr. (Hobbs 1961, 1976). Infrequently visit Nullarbor Plain, where recorded in Apr., only after heavy rain and flood conditions (Serventy & Whittell 1976; see Brooker *et al.* 1979). Arrive Rockingham district, WA, May; usually leave within 1–2 months but stayed till Nov. in 1940 (Sedgwick 1942); on Swan Coastal Plain, sw. WA, most abundant Apr.–June (Storr & Johnstone 1988). Abundant Edward R. area, Gulf of Carpentaria, Mar. and Apr., with few remaining by May (Garnett & Bredl 1985); not recorded Torres Str. (Draffan *et al.* 1983). In Darwin, numbers vary seasonally, suggesting passage through Top End; abundant Darwin and Alligator Rs Region, NT, during dry season, i.e. from Apr. (Crawford 1980; McKean 1981; Dostine & Morton 1989; Aust. Atlas). Extraliminally present New Guinea mainly from Feb. (Beehler *et al.* 1986); present Java, from May; specimens from Sulawesi, Aug.–Oct. (Mees 1977).

**Non-breeding** Mostly n. Aust., New Guinea and Indonesia. Recorded n. New Guinea (Sepik R.) Apr.–May and Oct. (see Coates 1985). In Java, Borneo, Sulawesi and Moluccas range overlaps with that of nominate *hybridus*. However, considerable temporal separation in occurrence of subspecies, e.g. in Java, subspecies *javanicus* present May–Sept. (once recorded Nov.), subspecies *hybridus* present Oct.–May (Mees 1977). In Sulawesi area, nominate *hybridus* less common than subspecies *javanicus* (Mees 1977; White & Bruce 1986). Subspecies *javanicus* probably only straggler to Philippines (collected Luzon and Mindanao) where nominate *hybridus* non-breeding visitor during austral summer (Delacour & Mayr 1946; Parkes 1958). N of Philippines, records apparently nominate *hybridus* (though said to be subspecies *javanicus* in literature that pre-dates Mees' [1977] review of taxonomy, e.g. Orn. Soc. Japan 1974). W of Java and Borneo, records probably nominate *hybridus* and only nominate *hybridus* recorded W of Sumatra (Mees 1977; Smythies 1986; van Marle & Voous 1988).

At some non-breeding areas in n. Aust. rainfall appears to affect occurrence (e.g. present Richmond R. district, Qld, in winter if rain recorded, Berney 1907) and numbers (e.g. numbers moving to coastal NT in dry season apparently greater following good wet season, Crawford 1980). At least some movements in n. Aust. related to availability of wetlands (e.g. in Kimberley, WA, retreat to permanent freshwater wetlands at height of dry season, Storr 1980). Some remain in S throughout year (Mees 1977); reporting rates in SE, Murray–Darling and SA Ras regions: 5.1% in summer, and 1.4% in winter (Aust. Atlas). In some areas in S, numbers can vary between years, e.g. in Vic., few remain most winters, but large numbers stay in some years (Vic. Atlas). Irregular in some s. areas during this period (e.g. swamps of Hunter R. floodplain, NSW, Gosper 1981) and occur in some inland areas only at this time (Storr 1986). NZ records (probably subspecies *javanicus*), Mar. and May–Oct. (see Distribution).

**Return** Extraliminally: recorded Java till Sept. (though recorded Nov.) (Mees 1977); passage migrant Bali, Sept. and Oct. (subspecies not known) (Ash 1984); in Sept. 1978, small group recorded Christmas I., Indian Ocean (Stokes *et al.* 1987); present New Guinea till Oct., though recorded s. New Guinea till Dec. or early Jan. (Coates 1985; Beehler *et al.* 1986). **Aust.** Abundant Darwin and Alligator Rs region, NT, till Oct. or Nov. (Crawford 1980; Dostine & Morton 1989; Aust. Atlas); numbers at Sanderson Sewage Ponds, Darwin, decrease Nov.–Feb. (McKean 1981). Summer visitor to Richmond R. district, Qld, after good wet seasons (Berney 1907); apparently irregular at Innisfail region, Qld, where recorded between Oct. and Feb. (Gill 1970). Regular to sw. NSW,

breeding if conditions suitable; appear from W in Sept., with numbers increasing through Oct. (Hobbs 1961). Recorded arriving Fivebough Swamp, NSW, in Sept.; large influx in 1985, with 2000+ on 21 Sept., which all left on 22 Sept. (NSW Bird Reps 1985, 1987). Arrive Vic., Sept. and Oct., with numbers increasing in some areas till Dec. (Belcher 1914; Sullivan 1929; Watson 1955; Bedgwood 1970). Some occasionally move S of breeding range: irregular in Bass Str. and Tas., where recorded Aug., Sept., Nov., Feb. and Apr. (see Distribution). Recorded Nullarbor Plain, Sept. and Oct. (Brooker *et al.* 1979); from Northam district, WA, between Sept. and Nov. (Masters & Milhinch 1974); most numerous Swan Coastal Plain, Sept.–Dec. (Storr & Johnstone 1988).

**Breeding** Between 1977 and 1981, all breeding was S of 25°S and mostly in e. Aust. (Aust. Atlas), though, at other times, also recorded at a few sites in n. Aust. (see Distribution). In s. Aust., most abundant in summer. Some occur n. Aust. during breeding period: e.g. Darwin, NT (McKean 1981); Townsville Town Common, Qld (Garnett 1983); Kimberley Div., WA (Storr 1980). In many n. Aust. localities numbers vary between years, e.g. usually few or none Darwin region, NT, Jan.–Apr., but more remain when wet-season rainfall low (Crawford 1972, 1980). Extraliminally: recorded Java (Mees 1977); a few recorded Port Moresby, New Guinea, though mostly absent Jan.–Mar. (Coates 1985). Some evidence that immatures remain in non-breeding areas in first summer, returning to breeding range when 2 years old (Mees 1977; see Banding).

During breeding period, movements in Aust. dispersive. Occurrence in many areas irregular (e.g. round Sydney, Hoskin 1991) with variation in numbers between years at many sites (e.g. sw. NSW, Hobbs 1961) probably in response to availability of wetlands. Unusual influxes sometimes recorded (e.g. Hobbs & Kaveney 1962). Often breed on floodwaters and colonies can form quickly. Said that time between arrival and departure at colony site as little as 40 days (Bourke 1956). Generally, breeding sites not used every year (Aust. Atlas), though recorded breeding at some sites in several consecutive years (e.g. Racecourse Lagoon, NSW, Gosper 1973). Sometimes breed in areas where occur only irregularly (e.g. Gascoyne Region, WA, Storr 1985a). Numbers on coast possibly affected by inland conditions (e.g. Watson 1955). In years when common at swamps of Richmond R. floodplain, NSW, and where sometimes breed, highest numbers in spring (Gosper 1981). In s. Vic., flocks recorded at one swamp for a few weeks without nesting (Portbury & Buntine 1961).

**Banding** Adult banded ICI Saltfields, SA, 15 Feb. 1980, found dead 6 Jan. 1985, 340 km SE at Bool Lagoon, SA (ABBBS 1985). Birds banded Aust. and recovered extraliminally: nestling banded Goose Lagoon, w. Vic., 6 Feb. 1965 recovered c. 3840 km N at Sepik R., New Guinea; one banded Ivanhoe, NSW, 18 Nov. 1974 recovered c. 5100 km NW at Cirebon, Java, first week Feb. 1976.

**FOOD** Carnivorous. Insects, crustaceans, fish and other small vertebrates, such as frogs; occasionally seeds, centipedes, spiders and young waterbirds. **Behaviour** Diurnal (Bourke 1956). Usually forage in small flocks over wetlands; also hawk over dry plains (Bourke 1956; Crawford 1977; Eames 1981). When feeding on wing, fly upwind, low (2–4 m) over water; rise at end of pass, flying quickly downwind to start again (Heather & Jones 1979). Three main methods of feeding: (1) PLUNGING: hover then dive, with wings raised, from 2–4 m above water (Hall 1902; Wall 1970; Heather & Jones 1979).

May also hover over ground then dive to take insects in paddocks (Eames 1981). (2) DIPPING: fly low over water, skimming surface to take insects from on or just below surface of water (Crawford 1977). (3) HAWKING: take insects up to 40 mm long; may hawk over dry plains (Bourke 1956; Crawford 1977). Occasionally opportunistic; flock of at least 100 recorded above group of Australian Pelicans *Pelecanus conspicillatus* and cormorants *Phalacrocorax* that were herding fish; Terns circled overhead, diving to take small fish, insect larvae or shrimps coming to surface (Carruthers 1969). Males have longer bills and wider gapes than females. In Alligator Rs region, NT, invertebrates comprised 49% by volume and 84% by number in diet, and vertebrates 51% and 13%; invertebrates dominated numerically but vertebrates comprised substantial proportion by weight. Main types of prey: aquatic invertebrates 17.6% vol., 13.7% no.; invertebrates of floating and emergent vegetation 23.4, 64.6; terrestrial invertebrates 7.6, 6.0; fish of vegetated littoral zone 8.7, 8.2; demersal fish 36.6, 5.2; amphibians 6.1, 2.4 (for details see below). Food of males and females differed markedly: males ate more fish of vegetated littoral than did females, and females ate more invertebrates than males. Males and females also differed in size of prey taken: females took shorter and more slender prey than did males (for more details, and statistical analysis, see Dostine & Morton 1989).

**Adult** In Alligator Rs Region, NT (55 stomachs, 672 items; Dostine & Morton 1989); summarized in Table 1. Plants: Nymphaeaceae: *Nymphaea violacea* sds tr. % wt, -%no., 3.6% freq.; Verbenaceae: *Phyla nodiflora* sds tr., -, 1.8. Animals: CRUSTACEANS: shrimps: Palaemonidae: *Macrobrachium* 4.8, 0.3, 3.6; ARACHNIDS: Araneae: spiders: unident. 1.4, 2.4, 7.3; Salticidae tr., 0.1, 1.8; Tetragnathidae: *Tetragnatha* 1.6, 5.2, 5.5; 12.1 mm (2.2; 5.0–15.6; 35); Pisauridae: *Dolomedes* 0.7, 1.9, 3.6; INSECTS: Odonata: Zygoptera: exuvia tr., 0.1, 1.8; Coenagrionidae: *Austroagrion exclamatoris* 0.1, 0.6, 7.3; *Ischnura heterosticta* 3.6, 14.4, 9.1; 29.1 (1.4; 26.7–30.3; 8); Anisoptera: unident. ads 0.2, 0.3, 3.6, larv. 0.8, 0.9, 9.1; Gomphidae: *Ictinogomphus australis* 1.0, 0.1, 1.8; Libellulidae: *Hydrobasileus brevistylus* 2.2, 0.6, 3.6; *Rhyothemis graphiptera* 0.7, 0.7, 3.6; *Tholymis tillarga* 0.1, 0.1, 1.8; *Trapezostigma loewi* 0.5, 0.1, 1.8; Blattodea 0.1, 0.1, 1.8; Orthoptera: Pyrgomorphidae: *Atractomorpha similis* 0.4, 0.4, 1.8; Acrididae: unident. 0.8, 0.3, 3.6; *Oxya japonica* 0.6, 0.1, 1.8; *Calephorops viridis* 0.2, 0.1, 1.8; Hemiptera: Cicadellidae tr., 0.1, 1.8; Gerridae tr., 0.1, 1.8; Notonectidae: *Enithares loria* 0.5, 2.2, 1.8; Naucoridae: *Naucoris* tr., 0.1, 1.8; Belostomatidae: *Diplonychus* 7.1, 6.5, 29.1; 15.9 (0.8; 12.3–17.5; 44); *Diplonychus* eggs 0.9, -, 14.5; Coleoptera: Carabidae 0.3, 0.7, 1.8; Noteridae tr., 0.1, 1.8; Dytiscidae: *Cybister* larv. 3.3, 2.5, 10.9; 37.6 (4.5; 30.2–42.8; 17); Hydrophilidae: *Berosus australiae* 0.1, 0.4, 1.8; *Enochrus* tr., 0.1, 1.8; *Helochaetes* tr., 0.3, 3.6; Scarabaeidae 2.6, 0.9, 3.6; Chrysomelidae: *Donacia* 5.8, 26.6, 18.2; 8.0 (0.7; 6.9–9.0; 14); Diptera: Tabanidae (three species) 2.2, 3.6, 3.6; Lepidoptera: Pyralidae larv. (14.4 [1.4; 10.8–16.7; 40]): unident. non-aquatic 0.3, 0.1, 1.8, unident. species A 0.5, 2.8, 5.4, unident. species B 0.5, 3.1, 9.1; Hymenoptera: Formicidae: unident. (four species) 0.2, 0.9, 5.5; *Oecophylla smaragdina* alates 4.3, 3.3, 5.5. FISH: Ambassidae: *Ambassis agrammus* 3.0, 3.4, 9.1; 20.4 (1.5; 17.2–23.0; 23); Atherinidae: *Melanotaenia splendida* 3.7, 1.3, 7.3; 30.3 (7.7; 24.2–46.1; 9); *Pseudomugil tenellus* 2.0, 3.4, 9.1; 21.0 (1.6; 18.2–25.2; 23); Eleotridae: *Mogurnda mogurnda* 17.1, 2.5, 10.9; 41.1 (9.6; 26.2–56.5; 17); *Oxyeleotris lineolatus* 5.9, 0.4, 3.6; 61.4 (3.8; 59.2–65.9; 3); *O. nullipora* 1.7, 1.3, 9.1; 25.2 (4.0; 17.4–33.1; 9); Plotosidae

unident. (predominantly *Porochilus rendahi*) 12.0, 0.9, 9.1; 69.4 (8.6; 56.3–83.5; 6). AMPHIBIANS: unident. larv. 0.2, 0.3, 1.8; Hylidae: *Litoria bicolor*: ads 0.4, 0.3, 3.6; larv. 2.9, 1.5, 7.3; *Litoria dahlii* 2.5, 0.3, 1.8.

Near Darwin, NT (4 stomachs, 43 items; Crawford 1977): Crustaceans tr.% no., in 1 stomach; Spiders 2.3, 1; Insects: Dermaptera 14.0, 3; Coleoptera: Dytiscidae larv. 9.3, 2; Hydrophilidae larv. 44.2, 2; Curculionidae 11.6, 1; Lepidoptera larv. 2.3, 1; Hymenoptera: Formicidae 11.6, 2; Amphibians: frogs 2.3, 1.

**Other records** Animals: Crustaceans<sup>16</sup>: shrimps<sup>5</sup>; Chilopods: centipedes<sup>15</sup>; Araneae: spiders<sup>16</sup>; Insects<sup>11</sup>: larv.<sup>5,13</sup>; Odonata: Zygoptera larv.<sup>16</sup>; Anisoptera: ads, larv.<sup>10,16</sup>; Lestidae: *Austrolestes* larv.<sup>3</sup>; Orthoptera: Tettigoniidae<sup>16</sup>; Acrididae<sup>16</sup>; Hemiptera: Gerridae<sup>16</sup>; Corixidae<sup>11,16</sup>; Coleoptera: water-beetles<sup>11</sup>; Carabidae; Dytiscidae larv.<sup>16</sup>; Hydrophilidae larv.<sup>16</sup>; Diptera<sup>11</sup>; Hymenoptera ads<sup>16</sup>; Ichneumonidae<sup>16</sup>: Formicidae: flying ants<sup>7,10</sup>. Fish<sup>1,5,6,11,12,16</sup>; Cyprinidae: Goldfish *Carassius auratus*; Poeciliidae: Mosquito Fish *Gambusia affinis*<sup>11</sup>. Amphibians: frogs: tadpoles<sup>2,6</sup>, ads<sup>2,4,8</sup>. Reptiles: lizard<sup>14</sup>. Birds: grebe chicks<sup>8</sup>. Mammals: House Mouse *Mus musculus*<sup>9</sup>. (REFERENCES: <sup>1</sup> Hall 1902; <sup>2</sup> Mathews 1909; <sup>3</sup> Brummitt 1938; <sup>4</sup> Bourke 1956; <sup>5</sup> Carruthers 1969; <sup>6</sup> Fordham 1971; <sup>7</sup> Crawford 1972; <sup>8</sup> Bowker 1973; <sup>9</sup> Hobbs 1976; <sup>10</sup> Crawford 1977; <sup>11</sup> Vestjens 1977; <sup>12</sup> Heather & Jones 1979; <sup>13</sup> Eames 1981; <sup>14</sup> Smith 1991; <sup>15</sup> HASB; <sup>16</sup> FAB).

**Young** First fed 80–125 min after hatching (Bourke 1956). Smaller items given to younger chicks (BWP). For first few days, parent lands to feed chick directly; three 4-day-old chicks received 11 meals/h from both parents. Later, parent just drops food, while still in flight, and young feeds itself. Fledged young occasionally fed by parent that has landed (Bourke 1956). Flying young alternate between catching insects on the wing and being fed on nest (Aust. NRS). Young chicks ignore large unmanageable items (e.g. young birds) offered as food (Bowker 1973). Crustaceans: notostracans: Triopidae: *Lepidurus*; freshwater crayfish; Insects: Orthoptera: Acrididae; Lepidoptera: Noctuidae larv.; Fish; Frogs: ads, tadpoles (Bourke 1956).

**Intake** Sometimes eat large numbers of single species of prey: one female, collected Nov., had eaten 85 *Donacia* (Coleoptera); another, May, 53 *Ischnura heterosticta* (Odonata); and a male, Aug., 19 *Ambassis agrammus* (Osteichthyes) (Dostine & Morton 1989). Over 100 winged ants (Formicidae) found in one stomach (Crawford 1977).

**SOCIAL ORGANIZATION** Poorly known in HANZAB region; for extralimital observations, see BWP. Gregarious; feed, roost, move, and nest in flocks (e.g. Portbury & Buntine 1961). Rarely seen singly; seen in twos (e.g. Bourke 1956; Gosper 1981), and small groups of 4–20 (Bourke 1956; Heron 1970; North), 30–60 (Sutton 1923; Bourke 1956; Bedgood 1973; Eames 1981); also in hundreds (e.g. Watson 1955; Bourke 1956; Carruthers 1969; Heron 1970) and, occasionally, thousands (e.g. Condon 1939; Bourke 1956; Eckert 1965). Immediately after breeding, flocks contain family parties; flocks comprising only juveniles also occur (Smith & O'Connor 1955; Bourke 1956). Associate with White-winged Black Terns and other terns (Smith 1965; H.M. Gibbs).

**Bonds** Assumed to be monogamous, but no information available on length of pair-bond (BWP). Age of first pairing not known (Portbury & Buntine 1961). **Parental care** Sexes share incubation and care of young (Smith & O'Connor 1955; Portbury & Buntine 1961), though Bourke (1956) claimed

that usually only females incubated and brooded, but did not indicate how he sexed birds. Young in post-breeding flock, just able to fly, fed by parents (Bourke 1956).

**Breeding dispersion** Nest in large, loose colonies, each pair defending small territory. Colonies recorded containing: thousands of birds (Stone 1912), at least 4000 birds (Bourke 1956) and c. 2000 nests (Disher 1966); small colonies added to by incoming flocks (HASB) (see also Distribution). Distance between nests varies; average 3.7 m apart (Bourke 1956); two clumps of ribbongrass, each c. 3 x 3 m, contained seven nests; smaller clumps contained one or two nests (Portbury & Buntine 1961); within about 1 m of each other (Stone 1912). Sometimes nest in association with other species (see Breeding). May fly up to c. 4.8 km with food for chicks (Bryant 1950).

**Roosting** During breeding season, some mates recorded roosting at night on nesting platforms with other parent; others used thicker clumps of reeds and small dead trees nearby; did not roost on water or in large trees nearby (Bourke 1956). Seen resting during day (H.M. Gibbs); on dead limbs near or over water, and on small stony island (North); on fence posts and logs; over 200 birds on one mudbank; flock of c. 200 rested up to 18 m above water on branches of emergent dead trees in lake. May make resting platforms (Bourke 1956). In nw. Aust., observed resting in loose association with other terns, especially White-winged Black Terns (H.M. Gibbs).

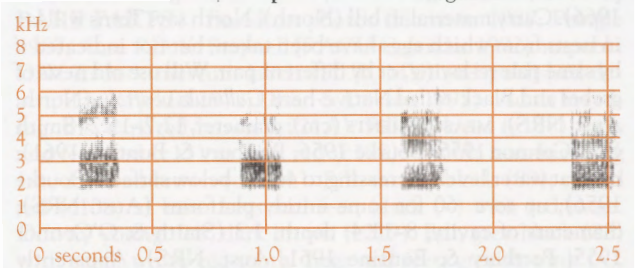
**SOCIAL BEHAVIOUR** Little information from HANZAB region; for extralimital account see BWP. Easy to watch from hide (Smith & O'Connor 1955; Bourke 1956); also settle on nests when observer crouched motionless (Bourke 1956). **Flock behaviour** Flocks may suddenly descend on lake or swamp, 'tumbling down from the sky' from great height (Bourke 1956). At Laverton, Vic., Dec., record of aerial flock display, function unknown: compact flock of 180 birds flew low over saltpans, then high into air; split into two compact groups (one larger than other); for several minutes birds performed aerobatics, flying in close formation, diving low over pans, then up high again, moving very fast and calling excitedly; left district soon afterwards (Watson 1955). In e. Riverina district, NSW, nesting Terns often seen to perform communal display flight for unknown reason: a dozen to hundreds of birds suddenly converged one above the other in column about ten birds wide; faced into wind, hovering for up to 1 min before quickly dispersing. Normally some of flock repeated behaviour a few seconds later, but sometimes all scattered at once; once there were three simultaneous columns involving nearly every Tern on the wetland (Bourke 1956).

**Sexual behaviour** One bird seen to fly round carrying grass then, on wing, offer it to another bird (Howard 1986). **Courtship feeding** Male often recorded feeding incubating female; male flew to nest, hovered c. 30 cm above it, dropped slightly and passed food to female; sometimes food dropped on nest-platform; female with young also recorded being fed (Bourke 1956).

**Relations within family group** Parents apparently induce young to stay close to water as it recedes in drying wetlands; two small young banded at nest-site found 1 week later over 800 m away on edge of receding water (Disher 1966). Chicks demand food by pecking at bill of adult; adult carries food in bill, then either gives it directly to chick or drops it nearby (latter even when chicks <2 h old) (Bourke 1956); chicks also fed by regurgitation (Smith & O'Connor 1955); method used possibly reflects type of food available. For

first 2 days, parents land to feed chicks at nest; parents then increasingly hover and pass food, then change to dropping food until, at 6–8 days old when chicks leave nest permanently, fed only by dropping food. Later, however, flying young resting on banks fed by adults passing food. May make feeding platforms. Chicks <4 days old can apparently recognize own parents, ignoring other adults (Bourke 1956). **Anti-predator responses of young** If on dry land, as soon as down has dried, will leave nest to hide in vegetation; if in floating nest, will respond to adults flying up and calling, by swimming from nest to hide in reeds up to c. 5 m away; return when danger has passed (Smith & O'Connor 1955; Bourke 1956). When disturbed by people, newly hatched chicks crawl from nest and lie flat on water (North). When left unattended, some young chicks crouch motionless in nests and are well camouflaged; even when handled, do not call or try to escape (H.M. Gibbs). **Parental anti-predator strategies** Whole colony will quickly fly to mob predator or intruder (Bourke 1956; Portbury & Buntine 1961); birds swoop down repeatedly with loud cries (Bourke 1956; Portbury & Buntine 1961) and may actually strike person with bill (Aust. NRS). Vigorously attack most intruders, e.g. Black-winged Stilts, Silver Gulls *Larus novaehollandiae*, Swamp Harriers *Circus approximans*, and people, but also recorded ignoring Black-winged Stilts, Australasian Tachybaptus *novae-hollandiae* and Hoary-headed *Poliiocephalus poliocephalus* Grebes, White-faced *Ardea novaehollandiae* and White-necked *A. pacifica* Herons, Yellow-billed Spoonbills *Platalea flavipes*, egrets *Egretta*, Black Swans *Cygnus atratus*, Grey Teal *Anas gracilis*, and Masked Lapwings *Vanellus miles* (Smith & O'Connor 1955; Bourke 1956; Portbury & Buntine 1961; Aust. NRS). Flock recorded apparently attacking Tern dying in water (possibly injured by Swamp Harrier). After disturbance, birds returning to nests hover above nests, uttering series of harsh loud calls, and then drop to platforms with wings raised, quickly folding them as they move to eggs (Bourke 1956).

**VOICE** Little information from HANZAB area. BWP describes seven calls, and presents two sonagrams.



A F. van Gessel; Darwin, NT, Jan. 1986; P36

**Adult** Loud hoarse screams or shrieks when swooping at human intruders near colony (Bourke 1956; Portbury & Buntine 1961; Campbell); calls in sonagram A may be this call. Loud harsh laughing notes uttered in a series while hovering above nest by birds returning to nest after disturbance by intruder (Bourke 1956); may correspond to Advertising Call of BWP. Sharp *keet* uttered when repeatedly dive-bombed by Welcome Swallow *Hirundo neoxena* (Brown & Habraken 1979). When feeding, utter harsh reedy calls, not so penetrating as those of other terns (HASB). Call excitedly while performing aerobatics in densely packed flock (Watson 1955).

**BREEDING** Fairly well known; detailed study by Bourke

(1956); 32 records in Aust. NRS up to Apr. 1993. Nest in colonies sometimes of thousands of birds; often breed after heavy rains flood low-lying areas (Bourke 1956; Aust. NRS). Entire breeding cycle may last 40 days (Bourke 1956). May nest in association with Hoary-headed and Australasian Grebes (Belcher 1902; North; Aust. NRS).

**Season** In e. Aust., usually Oct. to late Jan. (North). vic.: Eggs, Nov.–Jan. (Bright 1935; Smith & O'Connor 1955; Watson 1955; Portbury & Buntine 1961; Aust. NRS). nsw: Hatching, early Oct. and mid-Nov. (Bourke 1956). sa: eggs, Dec. and Mar. (Aust. Atlas; Aust. NRS). n. wa: Eggs, Mar and Apr. (Ford 1969; Kolichis 1992).

**Site** In swamps of lignum, water-ribbon, saltmarsh, and canegrass; flooded wheat paddock; marshy area of water storage area. Among tussocks, on clumps of water-ribbon or *Sarcocornia*, in water up to 1.8 m deep (Bryant 1950; Smith & O'Connor 1955; Bourke 1956; Portbury & Buntine 1961; Ford 1969; Kolichis 1992; North; Aust. NRS). Average distance between nests, c. 3.7 m (Bourke 1956; see also Breeding dispersion). Hoary-headed Grebes nest within and beside colonies of Terns, one within 90 cm of Tern nest; nests of Black Swan and Great Crested Grebe *P. cristatus* found within colony; nest of Baillon's Crake *Porzana pusilla* c. 2.7 m from Tern nest; nest of Black-winged Stilt c. 6.1 m from Tern nest; and nest of Red-kneed Dotterel *Erythronyx cinctus* nearby (Belcher 1902; Smith & O'Connor 1955; Portbury & Buntine 1961; Ford 1969; Aust. NRS). Nests of Australasian Grebes found at base of almost every bush supporting a Tern nest (North).

**Nest, Materials** Mound or platform of water ribbons, reeds, pin rush, sticks, grass, samphire and saltgrass, with neat saucer-shaped cavity in centre; some with raised edge c. 2.5 cm above platform. Floating, anchored to submerged water ribbon, or built on submerged or partly submerged lignum, saltbush, samphire, currant bushes, roly poly, on floating weeds or bent-over stalks; unlined or lined with green grass, gull feathers (Morgan 1931; Smith & O'Connor 1955; Bourke 1956; Portbury & Buntine 1961; Ford 1969; Aust. NRS). Nest begins as collection of damp weed, and added to as incubation proceeds, becoming a neat dry structure (Bright 1935; Disher 1966). Carry material in bill (North). North says Terns will lay in nests from which eggs have been taken, but not indicated if by same pair re-laying, or by different pair. Will use old nests of grebes and Black-tailed Native-hens *Gallinula ventralis* (North; Aust. NRS). **MEASUREMENTS** (cm): diameter, 12.7–15.2 (Smith & O'Connor 1955; Bourke 1956; Portbury & Buntine 1961); c. 30 at water level, increasing to 46–51 below surface (Bourke 1956); up to c. 60 for some untidy platforms (Aust. NRS); diameters of cavity, 8–11.4; depth, 1.3 (Smith & O'Connor 1955; Portbury & Buntine 1961; Aust. NRS). Apparently construct resting platforms for young (Bourke 1956).

**Eggs** Oval to pyriform, close-grained, usually slightly lustrous; ground-colour varies from bright green to pale olive-brown but usually dull greenish-grey (North), light green to light brown; markings range from spots to blotches of black and grey, normally denser towards larger end but occasionally evenly distributed (Portbury & Buntine 1961); some have irregular ring of blotches near larger end (Smith & O'Connor 1955); boldly spotted and blotched with penumbral markings of blackish brown and umber-brown, particularly on larger end, some becoming confluent and forming a more or less ill-defined zone, others with freckles and dots of same colour over entire surface of shell, intermingled with large underlying blotches of sepia and inky grey, some uniformly and thickly covered with small dots, spots and rounded markings of black-

ish brown, umber-brown and inky grey, latter appearing as if beneath shell (North). **MEASUREMENTS**: 37.9 (1.45; 35.3–39.9; 18) x 27.6 (0.59; 26.7–28.4) (Campbell; North); clutches of C/2, 39.2 (1.60; 37.3–41.5; 10) x 28.2 (0.69; 27.2–29.8); clutches of C/3, 38.4 (1.01; 36.3–39.6; 14) x 27.6 (0.97; 26.3–29.8) (Smith & O'Connor 1955).

**Clutch-size** Most clutches contain two or three eggs, occasionally four; average 2.5: C/1 x 2, C/2 x 14, C/3 x 20 (Portbury & Buntine 1961); 2.9: C/1 x 1, C/2 x 9, C/3 x 67, C/4 x 1 (Bourke 1956); two nests containing six eggs, no doubt double clutches (Disher 1966).

**Laying** Interval not known. Probably re-lay after failure; new nests found in remaining wet area of a swamp after colony deserted dried area (Portbury & Buntine 1961). A three-egg clutch contained two Tern eggs and one Australasian Grebe egg (Bright 1935).

**Incubation** Both sexes incubate; pair often on nest together (Portbury & Buntine 1961) (*contra* Bourke [1956] who said only female seen to incubate, is fed on nest by male, and items either passed to her or dropped on nest). Egg-shells and unhatched eggs removed from nest (Smith & O'Connor 1955). **INCUBATION PERIOD**: Not known; in w. Palaearctic, 18–20 days (BWP).

**Young** Precocial, nidifugous, ptilopaedic. Leave nest when down dry, to drink, float in water nearby or hide in vegetation (Smith & O'Connor 1955; Bourke 1956). A colony moved c. 800 m 12 days after general hatching period and gone c. 2 weeks later (Smith & O'Connor 1955). **Parental care, Role of sexes** Both sexes shelter young, and both parents sometimes at nest (Smith & O'Connor 1955), though Bourke (1956) said males rarely brood and that brooding female sometimes fed on nest during first 2 days after hatching. Both sexes feed young (Bourke 1956). Young receive their first feed 80–125 min after hatching (Bourke 1956). Young fed by regurgitation (Smith & O'Connor 1955), or food carried to nest and passed to chick or dropped near it (Bourke 1956). Young fed at nest during first 2 days; thereafter, food passed to young by hovering parents, then dropped to them until young leave nest, at 6–8 days. At a nest with three young, 4 days old: food brought 11 times in 1 h in mid-afternoon. Fed till after fledging, when parents alight alongside and pass food to young (Bourke 1956). Adults vigorously attack intruders in colony (Smith & O'Connor 1955). **FLEDGING PERIOD**: No precise determinations; probably fledge at between 14 and 18 days (Bourke 1956).

**Fledging to maturity** Leave nesting area soon after fledging, dispersal beginning within 1 week of fledging (Bourke 1956). Breed when still in immature plumage (Portbury & Buntine 1961).

**Success** Hatching success seemed to be 66% (Smith & O'Connor 1955), 96% (Bourke 1956). All clutches with only one egg failed to hatch (Smith & O'Connor 1955); for clutches of three eggs, one egg said to be infertile, as no broods of three young found (Stone 1912). Colonies deserted after swamps dry; nests washed away by sudden rise in water level (Bourke 1956; Portbury & Buntine 1961; North).

**PLUMAGES** Prepared by A.M. Dunn. Probably begin post-natal moult to juvenile plumage a few days after hatching. Complete post-juvenile moult to immature non-breeding (first basic) plumage begins soon after fledging. Subsequent moults of subadults poorly known. Adults moult twice annually: a complete post-breeding (pre-basic) moult occurs just before or during n. movements, and partial pre-breeding (pre-alternate)



moult occurs during s. movements, producing non-breeding and breeding plumages. Sexes similar but females sometimes have slightly paler underparts. Age of first breeding, unknown. Three subspecies; *javanicus* occurs Aust. and described below.

**Adult breeding** (Second and subsequent alternate). **Head and neck** Forehead, lores, crown, nape, hindneck and ear-coverts, black (89), forming neat cap extending to level with lower edge of eye. White streak extends from gape, across cheek to side of neck. Chin and throat, very pale grey (very pale 86); almost white on chin. **Upperparts** Light grey (85). **Underparts** Breast, light grey (85) to grey (84), gradually merging into dark-grey (83) to grey-black (82) belly, vent and flanks. Undertail-coverts, white. **Tail** Mostly grey (84) to light grey (85), sometimes with very narrow white fringes to feathers. T5 and T6, very pale (almost white) along outer margin. **Upperwing** Coverts, grey (84); alula slightly darker grey (c83). Outer primaries, light to pale grey, with silvery sheen, and broad concealed white inner edge, beginning c. 3 cm from tip; with wear, silvery sheen lost, and primaries appear grey-black (82), particularly at tips and where feathers overlap. Inner primaries grade inwards from grey-black (82) to grey (84) on p1, with paler inner web; inner primaries have little silvery sheen. Secondaries, grey (84) with white inner webs. Tertiaries, grey (84) grading to white near base of inner web. **Underwing** White except for primaries and tips of secondaries. Outer primaries, grey (84) with broad white inner edge. Innermost primaries mostly light grey (85) with narrow white inner edge. Most grey areas of primaries concealed; only tips of outer 4–5 primaries and outer edge of p10 appear dark in flight, forming dark leading-edge to outerwing and dark trailing-edge to outer primaries. Secondaries, white with grey (c84) tips and concealed light-grey (c85) outer edges; appear white with narrow grey trailing-edge.

**Adult non-breeding** (Second and subsequent basic). **Head and neck** Crown, mostly white, with dark-grey (83) to black (89) shaft-streaks to most feathers. Nape and hindneck, black (89) with narrow white fringes to feathers. Eye-stripe passing from just in front of eye to sides of nape, black (89). Rest of head, including forehead and anterior lores, white. **Upperparts** Mantle, white. Back, scapulars, rump and uppertail-coverts, pale grey (86). **Underparts** White. **Tail** Grey (84) to light grey (85) with narrow white fringes to feathers. **Wing** As adult breeding.

**Downy young** Based on photos (Pringle 1987; K. Stepnell [RAOU Calendar 1992]) and published descriptions (Fjeldså 1977). Covered with straight, soft, silky down. **Head and neck** Forehead, black (89). Crown and nape, buff-yellow (53) to buffish orange (c16) with three black (89) lines, or two black (89) lines with one or a few black (89) spots between them. Area round eye, lores and chin, white to off-white. Throat and sides of neck, black-brown (119) to black (89). Ear-coverts, cheeks and hindneck, buff-yellow (53) to buffish orange (c16). **Upperparts** Buff-yellow (53) to buffish orange (c16) with large ill-defined black (89) patches on sides of back and rump, sometimes joining to form broad irregular streaks. **Underparts** Off-white. **Wing-pads** Buff-yellow (53) to buffish orange (c16) with one or two black (89) spots. Wing-tips, white.

**Juvenile Head and neck** Forehead, usually off-white, with buff (c124) tinge and some dark-brown (219A) streaking on upper forehead; occasionally black (89). Crown, nape and hindneck often black (89), sometimes dark brown (219A) with some fine lighter brown (c239) streaking; form varying

dark cap. Chin, cheeks, throat and sides of neck, white, occasionally with some scattered patches of dark grey (83). Black (89) patch over ear-coverts. **Upperparts** Mantle, back and scapulars, dark brown (121) with pale-grey (86) to white bases and light-brown (223D) fringes to feathers. Rump and uppertail-coverts, pale grey with one or two dark-grey (83) blotches. **Underparts** Mostly white; occasionally with scattered dark-grey (83) to black (89) blotches, concentrated on breast and vent. **Tail** Mostly light grey (c85) with narrow white fringe and dark-grey (c83) subterminal band; some central feathers may have one or two small scattered grey-black (82) blotches. **Upperwing** Lesser secondary coverts, grey-brown (c91). Median and greater secondary coverts vary: some pale grey (86) with concealed dark-brown (221) bases; some pale grey (86) with light-brown (223D) tips and concealed dark-brown (221) bases; occasionally, dark brown (221) with light-brown (223D) tips. Alula, dark grey (83) with pale-grey (86) outer edge and dark red-brown (221A) tinge to tips. Primary coverts, grey (84) with pale-grey (86) fringes and dark-grey (83) shaft-streaks. Primaries and secondaries similar to those of adult but with less silvery sheen and appearing slightly browner. Tertiaries, dark brown (121) to black-brown (119) with light-brown (223D) fringes and pale-grey (86) bases. **Underwing** Coverts appear to vary individually; some mostly white, some white with scattered dark-grey to grey-black (83–82) flecks. Primaries and secondaries similar to adult.

**First immature non-breeding** (First basic). Similar to adult non-breeding but sometimes distinguished from adult before completion of prolonged post-juvenile moult by some retained tertiaries, scapulars and rectrices.

**First immature breeding** (First alternate). Poorly known and no information for HANZAB region; no specimens examined. In nominate *hybridus*, probably like first immature non-breeding (first basic) but generally with darker cap (though always with some white feathers) and often have a few scattered dark-grey feathers on belly (Olsen & Larsson 1995). Some possibly attain full adult breeding plumage and inseparable from adults (BWP) but confirmation needed.

**BARE PARTS** Based on photos (Harrison 1987; Pringle 1987; Aust. RD; K. Stepnell [RAOU Calendar 1992]; unpubl.: D.W. Eades), museum labels (HLW, MV) and published descriptions (Fjeldså 1977; Olsen & Larsson 1995). **Adult breeding** Iris, dark red-brown (c221A). Bill, dark red (c108). Legs and feet, red (c13) to dark red (c108). **Adult non-breeding** Iris, dark red-brown (c221A). Bill, mostly black (89); tinged red (c108) at base. Legs and feet, black (–) with red tinge. **Downy young** Iris, dark brown (c219). Bill, grey-black (82) with small white egg-tooth. Legs and feet, greyish pink (–). **Juvenile** Iris, dark brown (–). Bill, black (89). Legs and feet, brownish red (–).

**MOULTS** In n. hemisphere, moult complex, varies greatly, and often involves several generations of feathers (BWP). Known to suspend moult for long periods during unfavourable conditions, and to have up to five growing primaries when conditions favourable (BWP); often have three generations of feathers in wings, and most birds examined by Mees were moulting primaries (Mees 1977). Little information for Aust.; available data suggest Aust. birds show similar variation and opportunism in timing of moult. Timing probably depends on location and timing of breeding. **Adult post-breeding** (Pre-basic; probably second and subsequent). Complete; primaries outwards. Few adults in Aust. collections in body-moult.

Extralimital data suggests crown, mantle, scapulars and lores moulted first, followed by forehead, uppertail-coverts, underparts and tail (BWP). Aust. data suggests that moult of primaries may begin before moult of body. In se. Aust., most probably begin moult of body, Mar.–Apr., but some begin earlier, about Jan. Male collected New Guinea was moulting from breeding into non-breeding plumage in Mar. (Mees 1977). Begin moult of primaries when breeding finished. Few data for se. Aust., but moult probably begins late Dec. to early Jan. and finishes July–Aug. Only four birds collected in se. Aust. between late Dec. and May; these were moulting p1 in Dec., p3 in Jan. and p8 in May. None of 34 adults caught or collected in se. Aust. between Oct. and early Dec. was moulting (AM, HLW, MV; VWSG). In sw. and nw. Aust., NT and Qld, timing of moult of primaries varies, with no detectable pattern; in many months, some adults half-way through moult of primaries and others from same region not moulting. Most adults wintering in Java had active moult of primaries between May and Aug. (Mees 1977). **Adult pre-breeding** (Pre-alternate; probably second and subsequent). Partial; includes head, body, wing-coverts, tail and, sometimes, inner primaries. Timing depends on local breeding conditions. In e. Aust., most attain breeding plumage in about Oct., on arrival; this retained till moving N in Mar.–Apr. In WA, birds recorded in full breeding plumage in most months of year (Fuller 1963; MV, WAM). Only five of 58 Aust. adults had second wave of primary-moult and all these came from WA in Oct., Nov. and Jan. (AM, HLW, MV, QM, WAM). **Post-juvenile** (First pre-basic). Complete. Begins with feathers of mantle and scapulars, t1 and p1, soon after fledging; finished 2–3 months later, except for secondaries and outer primaries (BWP). No data for Aust. **First pre-breeding** (First pre-alternate). No Aust. data. In nominate *hybridus*: some moult at least some feathers of crown and underparts (see Plumages); some moult directly from first non-breeding (first basic) to another non-breeding plumage (BWP); some possibly moult like adult pre-breeding (BWP) but confirmation needed.

**MEASUREMENTS** (1–2) Aust., skins (AM, HLW, MV, QM, WAM): (1) Adults; (2) Immatures. (3) Alligator Rs Region, mostly non-breeding adults, recently dead; Gape probably depth of bill at gape (Dostine & Morton 1989).

	MALES	FEMALES	
WING	(1) 224.6 (5.99; 213–235; 26) (2) – (3) 217.9 (7.1; 19)	219.6 (7.66; 203–234; 19) 210.4 (1.34; 209–212; 5) 212.2 (8.5; 20)	* * *
TAIL	(1) 77.3 (3.69; 66–83; 27) (2) 70	73.5 (5.44; 63–82; 21) 73.0 (2.94; 69–76; 4)	** *
BILL	(1) 30.6 (1.29; 28.1–33.2; 27) (2) 26 (3) 30.9 (1.7; 19)	27.7 (1.33; 24.7–30.8; 21) 26.9 (1.17; 25.9–28.3; 5) 28.1 (1.1; 19)	** ** **
GAPE	(3) 13.6 (0.8; 19)	12.5 (1.0; 20)	**
TARSUS	(1) 23.1 (0.83; 21.2–24.6; 29) (2) 21.1 (3) 26.4 (0.9; 16)	22.5 (0.94; 20.7–24.2; 21) 21.9 (1.06; 21.0–23.6; 5) 25.2 (0.8; 18)	* * **
TOEC	(1) 27.3 (1.18; 25.2–29.4; 28) (2) 25.2	26.4 (0.97; 24.4–27.7; 21) 25.92 (0.70; 25.4–27.1; 5)	** *

In Alligator Rs Region, ratio of wing to culmen length in males, 7.1 (0.3; 18); females 7.6 (0.4; 19) (Dostine & Morton 1989).

(4) Aust., adults, live (VWSG).

## UNSEXED

WING	(4) 229.6 (5.55; 220–240; 12)
BILL	(4) 28.7 (1.81; 25.0–31.9; 13)
THL	(4) 64.0 (2.80; 61.3–68.7; 12)

**WEIGHTS** (1) Aust., adults, museum labels (AM, MV, QM, WAM). (2) Alligator Rs Region, mostly non-breeding adults (Dostine & Morton 1989).

	MALES	FEMALES	
(1)	90.0 (7.32; 80–110; 17)	77.8 (10.67; 60–96; 14)	**
(2)	82.4 (7.1; 18)	73.2 (7.9; 20)	**

Males significantly heavier than females. In Vic., unsexed adults in Nov.–Dec., 80.5 (8.57; 61–92; 13) (VWSG).

**STRUCTURE** Wing, long, narrow and pointed. Eleven primaries: p10 longest, p9 2–12 mm shorter, p8 19–27, p7 35–41, p6 52–60, p5 69–77, p4 85–94, p3 99–108, p2 113–123, p1 125–137; p11 minute. Fifteen secondaries, including three tertials; tips of longest tertials fall between p3 and p5 on folded wing. Tail, short, with shallow fork; 12 rectrices; t6 longest, t1 9–22 mm shorter. Bill, straight, pointed and slightly shorter than head. Tarsus, short and slender; scutellate in front, reticulate at rear. Tibia, partly feathered; 5–10 mm exposed. Outer toe 87–92% of middle, inner 63–67%, hind 28–32%.

**SEXING** Males significantly heavier and larger in all measurements than females. Length of bill could probably be used to sex most individuals as there was little overlap between sexes. Gonyes also appeared more pronounced on males than females. Plumage very similar, but females in breeding plumage appear to have slightly paler underparts.

**GEOGRAPHICAL VARIATION** Three subspecies; no variation within Aust. region. Subspecies differ slightly in size and markedly in colour. Nominative *hybridus* has slight clinal variation in size: largest in w. Europe and North Africa, becoming smaller in E. Subspecies *javanicus* of Aust. much paler than nominate *hybridus* in breeding, non-breeding and juvenile plumages; similar in size to nominate *hybridus* from e. Asia. Subspecies *delalandii* from s. and e. Africa darker than *hybridus* in breeding plumage, but inseparable in non-breeding and juvenile plumages (BWP); similar in size to nominate *hybridus* from w. Europe.

## REFERENCES

- ABBBS. 1985. *Corella* 9: 67–9.  
 Ali, S., & S.D. Ripley. 1969. *Handbook of the Birds of India and Pakistan*. 3. OUP, Bombay.  
 Alstrom, P. 1989. *Br. Birds* 82: 296–319.  
 Anon. 1983. *West. Aust. Bird Notes* 28: 9–10.  
 — 1992. *West. Aust. Bird Notes* 64: 3–4.  
 — 1993. *West. Aust. Bird Notes* 65: 2–3.  
 — 1994. *West. Aust. Bird Notes* 70: 2–3.  
 Ash, J.S. 1984. *Bull. Br. Orn. Club* 104: 24–35.  
 Austin, M. 1993. *Winging It* 5: 3.  
 Austin, T.B. 1907. *Emu* 7: 74–9.  
 Badman, F.J. 1979. *S. Aust. Orn.* 28: 57–81.  
 — 1981. *S. Aust. Orn.* 28: 141–53.  
 — 1989. *The Birds of Middle and Lower Cooper Creek in South Australia*. Nature Cons. Soc. S. Aust., Adelaide.

- Bamford, M. 1988. RAOU Rep. 41.
- Baxter, C. 1989. *An Annotated List of the Birds of Kangaroo Island*. SA NPWS, Kingscote, Kangaroo I., SA.
- Bedgood, G.W. 1970. *Aust. Bird Watcher* 3: 252–65.
- 1973. *Aust. Bird Watcher* 5: 12–22.
- Beehler, B.M., et al., 1986. *Birds of New Guinea*. Princeton Univ. Press, Princeton, New Jersey.
- Belcher, C.F. 1902. *Emu* 2: 33.
- 1914. *The Birds of the District of Geelong, Australia*. Griffiths, Geelong.
- Bellchambers, K., & G. Carpenter. 1990. *S. Aust. Orn.* 31: 1–7.
- Berney, F.L. 1907. *Emu* 6: 106–15.
- Bourke, P.A. 1956. *Emu* 56: 339–48.
- Bowker, G. 1973. *Aust. Bird Watcher* 5: 54.
- Braithwaite, L.W., et al. 1985a. *Tech. Memo. Div. Wildl. Rglds Res. CSIRO, Aust.* 21.
- , et al. 1985b. *Tech. Memo. Div. Wildl. Rglds Res. CSIRO, Aust.* 23.
- , et al. 1986. *Tech. Memo. Div. Wildl. Rglds Res. CSIRO, Aust.* 24.
- , et al. 1987. *Tech. Memo. Div. Wildl. Rglds Res. CSIRO, Aust.* 27.
- Bright, J. 1935. *Emu* 34: 293–302.
- Brooker, M.G. 1993. *Aust. Bird Watcher* 15: 13–18.
- , et al. 1979. *Emu* 79: 176–90.
- Brown, B., & A. Habraken. 1979. *Notornis* 26: 195–7.
- Brummitt, D.W. 1938. *S. Aust. Orn.* 14: 218–21.
- Bryant, C.E. 1950. *Emu* 49: 267.
- Carruthers, R.K. 1969. *Emu* 68: 280–2.
- Coates, B.J. 1985. *The Birds of New Guinea*. 1. Dove Pubs, Alderley, Qld.
- Condon, H.T. 1939. *S. Aust. Orn.* 15: 15.
- 1968. *Handlist of the Birds of South Australia*. S. Aust. Orn. Assoc., Adelaide.
- Crawford, D.N. 1972. *Emu* 72: 131–48.
- 1975. *S. Aust. Orn.* 193–5.
- 1977. *Emu* 77: 146–7.
- 1980. *Emu* 80: 166–9.
- Delacour, J., & E. Mayr. 1946. *Birds of the Philippines*. Macmillan, New York.
- de Schauensee, R.M. 1984. *The Birds of China*. OUP, Oxford.
- Dement'ev, G.P., & N.A. Gladkov. (Eds) 1951. *Birds of the Soviet Union*. 3. Israel Prog. Scient. Transl., Jerusalem (1969).
- Disher, P.A. 1966. *Aust. Bird Watcher* 2: 216–7.
- Dostine, P.L., & S.R. Morton. 1989. *Aust. Wildl. Res.* 16: 549–62.
- Draffan, R.D.W., et al. 1983. *Emu* 83: 207–34.
- Eames, A. 1981. *Bird Obs.* 589: 5.
- Eckert, J. 1965. *S. Aust. Orn.* 24: 68–9.
- Fjeldså, J. 1977. *Guide to the Young of European Precocial Birds*. Skarv. Nature Pubs, Strandgården, Tisvildileje.
- 1985. *Emu* 85: 141–9.
- Fletcher, A.W.J., et al. 1983. *Tas. Bird Rep.* 12: 24–5.
- Ford, J. 1969. *West. Aust. Nat.* 11: 69–70.
- Fordham, R. 1971. *Aust. Birds* 6: 7.
- Fuller, P.J. 1963. *West. Aust. Nat.* 9: 9–12.
- Garnett, S. 1983. *Birds of the Townsville Town Common*. Qld NPWS, Townsville.
- , & R. Bredl. 1985. *Sunbird* 15: 6–23.
- Gibson, D.F. 1986. *Cons. Comm. North. Terr. Tech. Rep.* 30.
- Gill, H.B. 1970. *Emu* 70: 105–16.
- Gosper, D.G. 1973. *Aust. Bird Watcher* 5: 35–9.
- 1981. *Corella* 5: 1–18.
- Green, R.H. 1989. *Birds of Tasmania*. Potaroo, Launceston.
- , & M.S. Field. 1982. *Notornis* 29: 337.
- Hall, R. 1902. *Emu* 2: 49–68.
- Harrison, P. 1987. *Seabirds of the World: A Photographic Guide*. Christopher Helm, Lond.
- Heather, B.D., & E.B. Jones. 1979. *Notornis* 26: 185–95.
- Hembrow, C.R. 1988. *Qld Nat.* 29: 15–16.
- Heron, S. 1970. *Aust. Bird Watcher* 3: 269–72.
- Hindwood, K.A. 1955. *Emu* 55: 257–8.
- Hobbs, J.N. 1961. *Emu* 61: 21–55.
- 1976. *Emu* 76: 219–20.
- , & M. Kaveney. 1962. *Emu* 61: 295–300.
- Hoskin, E.S. 1991. *Birds of Sydney*. Surrey Beatty, Sydney.
- Howard, M. 1986. *Aust. Bird Watcher* 11: 247–57.
- Jaensch, R.P., & R.M. Vervest. 1990. RAOU Rep. 32.
- , et al. 1988. RAOU Rep. 30.
- Kingsford, R.T., et al. 1988. *Tech. Memo. Div. Wildl. Ecol. CSIRO, Aust.* 30.
- , et al. 1989. *NSW Natm. Parks Wildl. Serv. Occ. Pap.* 8.
- , et al. 1990. *NSW Natm. Parks Wildl. Serv. Occ. Pap.* 9.
- , et al. 1991. *NSW Natm. Parks Wildl. Serv. Occ. Pap.* 10.
- , et al. 1992. *NSW Natm. Parks Wildl. Serv. Occ. Pap.* 12.
- , et al. 1993. *NSW Natm. Parks Wildl. Serv. Occ. Pap.* 16.
- , et al. 1994. *NSW Natm. Parks Wildl. Serv. Occ. Pap.* 18.
- Kolichis, N. 1992. *West. Aust. Nat.* 19: 67–8.
- Lamm, D.W. 1965. *Emu* 64: 115–28.
- Masters, J.R., & M.L. Milhinch. 1974. *Emu* 74: 228–44.
- Mathews, G.M. 1909. *Emu* 9: 53–65.
- McEvey, A. 1965. *Emu* 65: 1–56.
- McGill, A.R. 1945. *Emu* 45: 83–7.
- McKean, J.L. 1981. *A'sian Seabird Grp Newsl.* 15: 11–16.
- Mees, G.F. 1977. *Zool. Verh., Leiden* 157: 1–64.
- Morgan, A.M. 1931. *S. Aust. Orn.* 11: 53–61.
- Morton, S.R., et al. 1993. *Wildl. Res.* 20: 203–17.
- Morris, A.K., et al. 1981. *Handlist of Birds in New South Wales*. NSW Field Orn. Club, Sydney.
- Olsen, K.M., & H. Larsson. 1995. *Terns of Europe and North America*. Christopher Helm, Lond.
- Nielsen, L. 1963. *Aust. Bird Watcher* 2: 58–9.
- Orn. Soc. Japan. 1974. *Check-list of Japanese Birds*. Gakken, Tokyo.
- Parker, S.A. 1969. *S. Aust. Orn.* 25: 59–71.
- Parkes, K.C. 1958. *Emu* 58: 288.
- Portbury, M.C., & D.W. Buntine. 1961. *Aust. Bird Watcher* 1: 135–8.
- Pringle, J.D. 1987. *The Shorebirds of Australia*. Angus & Robertson, Sydney.
- Roberts, G.J. 1979. *The Birds of South-East Queensland*. Qld Cons. Council, Brisbane.
- 1981. *S. Aust. Orn.* 28: 175–7.
- Saunders, D.A., et al. 1987. *West. Aust. Nat.* 16: 191.
- Schodde, R. 1976. *A Survey of the Fauna of the Lower McArthur River Region, Northern Territory*. CSIRO Div. Wildl. Res. for Mimets Dev't, Canberra.
- Sedgwick, E. 1942. *Emu* 41: 281–8.
- Serventy, D.L., & H.M. Whittell. 1976. *Birds of Western Australia*. Univ. West. Aust. Press, Perth.
- Smith, A., & L. O'Connor. 1955. *Emu* 55: 255–6.
- Smith, F.T.H. 1965. *Aust. Bird Watcher* 2: 128–34.
- 1991. *Bird Obs.* 714: 118.
- Smythies, B.E. 1986. *The Birds of Burma*. Nimrod, England.
- Start, A.N., & P.J. Fuller. 1983. *Wildl. Res. Bull. West. Aust.* 12: 94–108.
- Stokes, T., et al. 1987. *Aust. Bird Watcher* 12: 1–7.
- Stone, A.C. 1912. *Emu* 12: 112–22.
- Storr, G.M. 1977. *Spec. Pubs West. Aust. Mus.* 7.
- 1980. *Spec. Pubs West. Aust. Mus.* 11.
- 1984. *Rec. West. Aust. Mus. Suppl.* 16.
- 1985a. *Rec. West. Aust. Mus. Suppl.* 21.
- 1985b. *Rec. West. Aust. Mus. Suppl.* 22.
- 1986. *Rec. West. Aust. Mus. Suppl.* 26.
- , & R.E. Johnstone. 1988. *Rec. West. Aust. Mus. Suppl.* 28.
- Stove, K. 1994. *S. Aust. Orn.* 31: 195–265.
- Sullivan, C. 1929. *Emu* 29: 39–44.
- Sutton, J. 1923. *S. Aust. Orn.* 7: 51–61.
- Taylor, P.M. 1987. *S. Aust. Orn.* 30: 62–73.
- Templeton, M.T. 1992. *Sunbird* 22: 87–110.
- Urban, E.K., et al. 1986. *The Birds of Africa*. 2. Academic Press, Lond.
- van Marle, J.G., & K.H. Voous. 1988. *BOU Checklist* 10.
- Vervest, R. 1989. *West. Aust. Bird Notes* 52: 2–3.
- Vestjens, W.J.M. 1977. *Tech. Memo. Div. Wildl. Res. CSIRO, Aust.* 12.
- Wall, L.E. 1970. *Emu* 70: 142.
- Watson, I.M. 1955. *Emu* 55: 224–48.
- Wheeler, W.R. 1967. *Handlist of the Birds of Victoria*. VORG, Melbourne.
- White, C.M.N., & M.D. Bruce. 1986. *BOU Checklist* 10.



Volume 3, Plate 43 [caption error corrected from original]

Whiskered Tern *Chlidonias hybridus* (page 765)

1 Adult breeding; 2 Adult non-breeding; 3 Downy young; 4 Juvenile; 5 Early stage of moult from juvenile to first immature non-breeding

White-winged Black Tern *Chlidonias leucopterus* (page 776)

6 Adult male breeding; 7 Adult non-breeding; 8 Downy young; 9 Juvenile

Black Tern *Chlidonias niger* (page 785)

Subspecies *surinamensis*

10 Adult male breeding; 11 Adult non-breeding; 12 Juvenile



M. S. BARNARD, 1991

**Volume 3, Plate 44** [caption errors corrected from original]

Whiskered Tern *Chlidonias hybridus* (page 765)

1 Adult breeding; 2 Adult non-breeding; 3 Juvenile; 4 Early stage of moult from juvenile to first immature non-breeding

White-winged Black Tern *Chlidonias leucopterus* (page 776)

5 Adult male breeding; 6 Adult non-breeding; 7 Late stage of moult from juvenile to first immature non-breeding, first austral autumn

Black Tern *Chlidonias niger* (page 785)

Subspecies *surinamensis*

8, 9 Adult male breeding; 10 Adult non-breeding; 11 Late stage of moult from juvenile to first immature non-breeding, first austral autumn; 12 Second immature breeding